COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER DIVISION
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Subject: Guidance Memo No. 09-2006
2010 Water Quality Assessment Guidance Manual

To: Regional Directors

From: Ellen Gilinsky, Ph.D., Director

Date: April 7, 2010

Copies: Alan Pollock, Regional Water Quality Planning Managers and staff, Office of Water Quality Programs Managers, WMA Staff

Summary:

The Environmental Protection Agency's (EPA) original 2006 Integrated Report Guidance and subsequent 2010 clarification guidance issued on May 9, 2009 recommended that states submit an "Integrated Report" that will satisfy Clean Water Act (CWA) requirements for both Sections 305(b) water quality reports and 303(d) impaired waters lists. According to EPA this Integrated Report should include the following information:

- delineation of water quality assessment units (AUs) based on National Hydrography Dataset (NHD);
- status of and progress toward achieving comprehensive assessments of all waters;
- Water Quality Standard attainment determination for every AU;
- additional monitoring that may be needed to determine Water Quality Standard attainment status and, if necessary, to support development of Total Maximum Daily Loads (TMDLs) for each pollutant/AU combination;
- schedules for additional monitoring planned for AUs;
- pollutant/AU combinations still requiring TMDLs;
- TMDL development schedules reflecting the priority ranking of each pollutant/AU combination; and
- Water Quality "Effluent Limited" Waters.

DEQ has incorporated the EPA Integrated Reporting guidance into the 2010 DEQ assessment guidance. It is essentially the same overall guidance used in 2008 with the addition of an EPA subcategory (5M) for atmospheric mercury impairments, as well as changes summarized below, and is designed to integrate or combine the 305(b) overall assessment of Virginia's waters and separate out those waters impaired and needing a TMDL as per 303(d). The EPA 2010 Integrated Report Guidance and Assessment Database (ADB V2.3.1) has 5 different assessment categories with some having subcategories, in which every segment or "assessment unit" (AU) will be placed. The US EPA Integrated Report Guidance allows the states to subdivide the federal Categories in order to address state programmatic needs. This guidance contains the Categories Virginia has chosen and subdivided the categories for enhanced tracking and data management purposes.

In addition to the EPA 2010 assessment guidance clarifications and updates, several additional assessment methodologies and clarifications have been included in the 2010 assessment guidance. These adjustments and additions are primarily a result of triennial review modifications that were adopted by the State Water Control Board (SWCB) in October 2008 and EPA approved on December 31, 2009. These modifications include the use of natural condition studies to identify natural conditions for pH and dissolved oxygen (DO) in Class VII (swamp waters). The studies allow DEQ to determine if anthropogenic influences are affecting water quality and causing an impairment.

A revised methodology has been drafted to assess nutrient influences on man-made lakes and reservoirs identified in 9 VAC-25-260-187 (§187 lakes). In addition to §187 nutrient assessment methodologies, the DO criteria assessment for these lakes has been modified based on stratification, to include DO assessment in the epilimnion only during stratification while assessing the whole water column when deemed not stratified.

Another 2010 triennial review related assessment update are revisions to many toxic pollutant criteria. These revisions are primarily related to human health as it relates to fish consumption assessments but also may affect public water supply criteria assessments.

The final major revision is the inclusion of "nested" waters within an approved watershed TMDL and not listing the nested impairment as needing a separate TMDL. This nested TMDL concept primarily involves bacteria impairments associated with recreation and shellfish consumption TMDLs but may also include benthic impairments depending on the stressor(s) involved.

The data window used in the development of the Integrated Report is January 1, 2003 through December 31, 2008. The manual uses excerpts from the "EPA 2006 Integrated Report Guidance", "2008 and 2010 EPA Integrated Report Clarification Guidance", "EPA 1997 Guidelines for the Preparation of the 1998 State Water Quality Assessment 305(b) Reports", and "Assessment Database (ADB) Systems User's Manual" published by EPA, along with other State and Federal guidelines.

Electronic Copy:

An electronic copy of this guidance in PDF format is available for staff internally on DEQNET, and for the general public on DEQ's website at: http://www.deq.virginia.gov/water.

Contact information:

If you have any questions regarding the guidance manual, you can contact Harry Augustine, Department of Environmental Quality, P.O. Box 1105, Richmond, Virginia 23218. Telephone (804) 698-4037, FAX (804) 698-4032, or via e-mail harry.augustine@deq.virginia.gov.

Disclaimer:
This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. However, it does not mandate any particular method nor does it prohibit any particular method for the analysis of data, establishment of a wasteload allocation, or establishment of a permit limit. If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.

WATER QUALITY
ASSESSMENT GUIDANCE MANUAL
for

Y2010

305(b)/303(d) Integrated Water Quality Report

April 2010

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Introduction
Under the Clean Water Act, EPA requires that each state develop a program to monitor the quality of its surface and ground waters and prepare a report every 2 years describing the status of its water quality. Each state identifies waters of concern as having observed effects and schedules additional monitoring, if appropriate, to determine if designated uses are being met. The EPA issues guidelines for States to use during the reporting cycle for national consistency purposes. States are encouraged to use these guidelines to prepare these water quality reports for EPA. EPA compiles the data from the State reports, summarizes them, and transmits the summaries to Congress, including an analysis of water quality nationwide. This 305(b)/303(d) integrated process is the principal means by which the EPA, Congress, and the public evaluate current water quality, the progress made maintaining and restoring water quality and the extent of remaining work to be done. Many States, including Virginia, rely on the 305(b)/303(d) process for information needed to conduct water quality planning. The 305(b)/303(d) process is an integral part of Virginia's water quality management program, requirements for which are set forth in 40 CFR 130.

The Water Quality Monitoring, Information, and Restoration Act (WQMIRA) directs DEQ to develop and publish a water quality assessment guidance document governing the process for defining and determining impaired waters, and to provide an opportunity for public comment on this assessment guidance. Public comment is solicited through July 24, 2009 on a draft of this guidance. The processes and procedures for defining and determining impaired waters are contained in this draft guidance document and were public noticed in the Virginia Register on June 22, 2009. Additionally, this guidance document can be found on the DEQ website at ***http://www.deq.virginia.gov/wqa/.***

The Water Quality Monitoring, Information, and Restoration Act (WQMIRA) requires the former 303(d) and 305(b) reports, now combined into the Integrated Report, be developed in consultation with scientists from State universities prior to the submission of these documents to the U.S. Environmental Protection Agency (EPA). In order to meet this directive, DEQ has updated this guidance containing the assessment procedures used to assist scientists in the review of previous Integrated Reports.

Purpose
The purpose of this guidance manual is to guide DEQ regional and central office staff in the development and reporting of the 2010 Integrated Report (305(b) Water Quality Assessment 305(b)/303(d) Impaired Waters). It is also intended to assist the public in its understanding of the monitoring and assessment process.

Section 305(b) of the Clean Water Act requires each State to submit a biennial report to EPA describing the quality of its navigable waters. The 305(b) report provides DEQ's best overall assessment of water quality conditions and trends in the Commonwealth. The report is intended to be used as a tool in planning and management (40 CFR 130, page 4) of waters in Virginia. The report also directs continuous planning and implementation activities in coordination with the State Water Quality Management Plan and the Continuous Planning Process (CPP).

Primary objectives of the Integrated Report are:

1. To educate and inform citizens and public officials about Virginia's overall water quality.

2. To analyze water quality data in order to determine the extent to which Virginia's waters are supporting the designated uses for all state waters and to compare the results to WQ Standards and other appropriate criteria and guidelines.

3. To determine the causes for the "failure to support" the designated uses of the State's waters.

4. To determine the nature and recognizable extent of point and nonpoint source impacts in accordance with state and federal guidelines.

Section 303(d) of the Clean Water Act and the Environmental Protection Agency's regulation 40 CFR Section 130.7 (d), promulgated in July 1992, requires each state to submit a Total Maximum Daily Load (TMDL) Priority List to EPA on April 1 of even numbered years. Category 5 is a summary of those waters that are impaired and need a TMDL.

Category 4 includes waters that are "water quality effluent limited" and other waters not needing a TMDL. Water Quality Limited waters are those waters where Standards are not expected to be met with the application of technology based effluent control technology of secondary treatment and best practicable treatment. Waters receiving effluent from facilities with water quality based effluent limits in their Virginia Pollution Discharge Elimination System (VPDES) permits with schedules of compliance to meet these limits within the next reporting cycle or within the current permit cycle (5 years) are considered Subcategory 4B (impaired but not needing a TMDL) due to the control requirements and compliance schedules associated with the VPDES permit or other alternative control requirements. Waters, where compliance schedules extend past the current permit cycle or into the next assessment cycle, are considered part of the 303(d) impaired waters list (Subcategory 5E) that need additional compliance review and tracking until the compliance schedule falls within the next reporting or permitting cycle. See the Background section for additional Integrated Report Category descriptions.

Background

EPA's Integrated Report Guidance recommends that states submit an "Integrated Report" that will satisfy Clean Water Act (CWA) requirements for Sections 305(b) overall water quality report, 303(d) impaired waters list and Section 314 assessment of publicly owned lakes. This Integrated Report shows the following information:

- delineation of water quality assessment units (AUs) based on National Hydrography Dataset (NHD);
- status of and progress toward achieving comprehensive assessments of all waters;
- Water Quality Standard attainment status for every AU assessed;
- additional monitoring that may be needed to determine Water Quality Standard attainment status and, if necessary, to support development of TMDLs for each pollutant/AU combination;
- schedules for additional monitoring planned for AUs;
- pollutant/AU combinations still requiring TMDLs; and
- TMDL development schedules reflecting the priority ranking of each pollutant/AU combination.
- Water Quality "Effluent Limited" Waters.

DEQ has incorporated the Integrated Reporting guidance EPA initially developed in 2004 with supplemental EPA guidance and clarification included in the assessment guidance. The 2010 Integrated Report guidance is similar to previous guidance in most areas and is designed to integrate or combine the 305(b) overall assessment of Virginia's waters and separate out those waters impaired and needing a TMDL as per 303(d). The 2010 EPA Integrated Report Guidance and Assessment Database (ADB V2.3.1) has five (5) federal categories with category 4 having 3 subcategories in which every "assessment unit" (AU) will be placed based on designated use attainment. Additionally, Virginia has incorporated several subcategories to supplement the federal categories enabling a more precise water quality tracking and reporting mechanism.

Below are the US EPA defined Categories followed by associated Virginia defined subcategories**:**

<u>FULLY SUPPORTING</u> - Waters are supporting one or more designated uses

- **EPA Category 1 -** Attaining all associated designated uses and no designated use is threatened

  Va. Category 1A - waters are attaining all uses and a TMDL has been developed for one or more uses.

- **EPA Category 2 –** Available data and/or other information indicate that some, but not all of the designated uses are supported.

  Va. Category 2A - waters are supporting all of the uses for which they are monitored.

  Va. Category 2B - waters are of concern to the state but no Water Quality Standard exists for a specific pollutant, or the water exceeds a state screening value or toxicity test.

  Va. Category 2C - waters are now attaining the use(s) for which they were originally 303(d) listed and the TMDL is EPA approved but other applicable use(s) were not monitored and assessed.

<u>INDETERMINATE</u> - Waters needing additional information

- **EPA Category 3 -** Insufficient data and/or information to determine whether any designated uses are met

  Va. Category 3A - no data are available within the data window of the current assessment to determine if any designated use is attained and the water was not previously listed as impaired.

  Va. Category 3B - some data exists but are insufficient to determine support of designated uses. Such waters will be a prioritized for follow up monitoring, as needed.

  Va. Category 3C- data collected by a citizen monitoring or other organization indicating water quality problems may exist but the methodology and/or data quality has not been approved for a determination of support of designated use(s). These waters are considered as having insufficient data with observed effects. Such waters will be prioritized by DEQ for follow up monitoring.

  Va. Category 3D - data collected by a citizen monitoring or other organization indicating designated use(s) are being attained but the methodology and/or data quality has not been approved for such a determination.

<u>IMPAIRED</u> - Waters are impaired or threatened but a TMDL is not required.

- **EPA Category 4A –** water is impaired or threatened for one or more designated uses but does not require a TMDL. A new TMDL is not necessary to address the newly identified impaired tributaries if TMDL modeling, source identification and reductions cover the entire watershed and the TMDL has been approved by EPA. These waters are primarily related to shellfish and/or recreational bacteria impairments but could include benthic impairments.

- **EPA Category 4B -** water is impaired or threatened for one or more designated uses but does not require the development of a TMDL because other pollution control requirements (such as VPDES limits under a compliance schedule) are reasonably expected to result in attainment of the Water Quality Standard by the next reporting period or permit cycle.

- **EPA Category 4C -** water is impaired or threatened for one or more designated uses but does not require a TMDL because the impairment is not caused by a pollutant and/or is determined to be caused by natural conditions.

<u>IMPAIRED</u> - Waters are impaired or threatened and require a TMDL

- **EPA Category 5 - Waters are impaired or threatened and a TMDL is needed.**

  Va. Category 5A - a Water Quality Standard is not attained. The water is impaired or threatened for one or more designated uses (excluding shellfish use) by a pollutant(s) and requires a TMDL (303d list).

  Va. Category 5B - the Water Quality Standard for shellfish use is not attained. One or more pollutants causing impairment require TMDL development.

  Va. Category 5C - the Water Quality Standard is not attained due to "suspected" natural conditions. The water is impaired for one or more designated uses by a pollutant(s) and may require a TMDL (303d list). WQ Standards for these waters may be re-evaluated due to the presence of natural conditions.

  Va. Category 5D - the Water Quality Standard is not attained where TMDLs for a pollutant(s) have been developed but one or more pollutants are still causing impairment requiring additional TMDL development.

  Va. Category 5E - effluent limited facilities are not expected to meet compliance schedules by next permit cycle or reporting period.

  Va. Category 5F - the Water Quality Standard is attained for a pollutant(s) with a TMDL and 303(d) delisting approved but the water remains impaired for additional pollutant(s) requiring TMDL development.

- **EPA Category 5M** – the Water Quality Standard is not attained for mercury primarily due to atmospheric deposition.

PART I 305(b)/303(d) ASSESSMENT PROCESS

Guidance Disclaimer

This guidance document has been developed based on current Water Quality Standards and Virginia's interpretation of those Standards. EPA approved the Triennial Review Standards revisions on December 29, 2009 becoming effective on February 1, 2010 and used in the 2010 assessment.

Virginia's biennial water quality assessment is conducted by the Department of Environmental Quality (DEQ), with the assistance of the Department of Conservation and Recreation (DCR), to determine the water quality conditions in the Commonwealth. The results of this water quality analysis are reported to the EPA in the Integrated Report due on April 1 of even numbered years. The Integrated Report describes the aggregated water quality conditions of the State. Additionally, the Integrated Report contains the individual listing of those waters identified as "impaired" for one or more designated uses and needing a Total Maximum Daily Load (TMDL). As per EPA guidance, the former 305(b) Water Quality Assessment Report and the 303(d) Impaired Waters List are now combined into a single Integrated Report. EPA compiles the data from all State reports into a national water quality status report that is presented to Congress.

Impaired waters needing a TMDL are those waters that do not meet WQ Standards due to a pollutant(s). *A pollutant, as defined in 40 CFR 122.2, means any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.*

The assessment begins by analyzing all QA/QC approved data from DEQ ambient water quality monitoring stations, biological, sediment and fish tissue monitoring, other special studies and/or other non-DEQ water quality data for the 6-year assessment period. As in 2008, DEQ has incorporated a 6-year assessment window to correspond with the current 2-year ambient rotating watershed monitoring program. It is anticipated that a trend analysis will be conducted at the end of each 6-year rotating watershed cycle or every six years. The results of these comprehensive data analyses are compared to both numeric and narrative criteria related to the designated uses contained in the WQ Standards. The WQ Standards are provisions of State and/or Federal regulations that contain numeric and/or narrative criteria for protecting the designated uses of all waters in the Commonwealth.

There are two basic types of water quality data used in the assessment process. The first type of data is QA/QC approved "monitored" data. This data comes from the collection and analysis of chemical, biological, and/or physical samples taken by DEQ and/or any other DEQ approved data submitted during the reporting period. These data are considered the highest quality data. Normally, the 303(d) Impaired Waters list is comprised of only QA/QC approved monitored data due to the assessment confidence associated with the QA/QC monitoring requirements. Monitored data is obtained using EPA accepted methods and DEQ approved protocols. All non-DEQ monitoring submittals, except USGS chemical data submittals, must provide a sampling and analysis protocol and all field data for review. If data discrepancies or other suspect information is generated, a field verification audit will be conducted by DEQ monitoring staff. Partially approved monitoring data can be used to signify waters as "insufficient but having observed effects" where DEQ assessment methodologies, had they been used, would show degradation (Category 3C). These waters should be prioritized for follow up monitoring. Partially approved monitoring data, where DEQ assessment methodologies would show fully supporting results, are considered insufficient data with low priority for follow up monitoring (Category 3D). These data could include results from water quality test kits or other alternate biological methodologies that do not provide the quality assured accuracy needed to confirm WQ Standards exceedences but can provide an accurate indication of good water quality or other observed effects.

The second type of data used in the assessment is considered "evaluated" data. These physical, chemical and/or biological data are primarily obtained from sources where there is not an EPA accepted sampling protocol and/or DEQ non-approved sampling and analysis protocols. An example of evaluated data would be data generated by water quality indicator test kits. These data are considered to be of lower quality with less

confidence in their results and normally are not used directly for listing waters as fully supporting or impaired but on a case by case basis, as having observed effects. Assessment Units, where lower quality data indicate chronic and recurring water quality degradation, may be designated as insufficient but having observed effects for associated designated uses on a case by case basis. Additional DEQ monitoring shall be targeted for these waters as resources allow. Additionally, waters that were fully supporting or on previous 303(d) lists, with no additional monitoring data for the 2010 reporting cycle, will retain previous assessment results for associated designated uses. Additional information concerning assessment and use of Citizen Monitoring and other non-DEQ data can be found in Part VI, Sections 6.3.1 and 6.3.2.

The following approval process will be used for non-DEQ "monitored" data protocol and QA/QC procedure review:

All ancillary data that have been received and reviewed by DEQ and found acceptable shall be used for the Integrated Report. The data are from two categories, state/federal/local agencies (other than DEQ) and the Citizen Monitoring Program. The approval process for data from the Citizen Monitoring Program is addressed in Part VI, Section 6.3.1. The following addresses the approval process for data from non-agency providers.

All "monitored" chemical and biological data must be supported by EPA accepted monitoring protocols. QA/QC procedures must also be reviewed and approved by DEQ. As regional assessment staff becomes aware of data sources, those parties generating data for DEQ assessment consideration should be requested by the regional assessment staff or Water Quality Assurance (QA) Coordinator to submit QA/QC plans, standard operating procedures (SOPs), and monitoring procedures to the DEQ QA Coordinator. The QA Coordinator will provide copies of supporting documentation for chemical data to QA/QC review staff in the Water Monitoring and Assessment (WMA) program and provide copies of all supporting documentation for biological monitoring of freshwater benthic macroinvertebrates to the Biological Monitoring Coordinator.

Benthic information from non-DEQ sources that meet 'Level III' classification according to Guidance Memo No. 06-2010: Guidelines for DEQ Review and Approval of Biological Monitoring QAPPs Submitted by Non-DEQ Sources shall be assessed by regional biologists. In addition, benthic information that does not meet Level III classification may be independently assessed by regional biologists according to non-agency benthic assessment guidance to determine their acceptability for assessment purposes on an individual basis. Copies of the supporting documentation for freshwater benthic data should be provided to the regional offices where the surveyed sites are located for review by the regional biologists. The regional biologists are most familiar with the various eco-regions in the state and are knowledgeable about location of appropriate reference sites, conditions or benthic metrics that are acceptable for assessing streams in these eco-regions. The regional biologists, in consultation with the biological coordinator, shall review the sampling and analysis methodology and if practical, the available data, to determine the acceptability of the benthic data. The regional biologists will provide any comments or requests for additional information directly to the data generators and will copy such communications to the DEQ Biological Monitoring Coordinator. Copies of the review results shall be distributed to the regional assessment staff and the DEQ 305(b) Coordinator. If the protocols involve estuarine toxics data and/or biological assessments in tidal environments, supporting documents should be provided to and reviewed by the Chesapeake Bay Program staff.

All comments concerning toxics data, chemical (SOPs) and/or QA/QC plans will be coordinated through the Water Monitoring and Assessment (WMA) QA Coordinator. The WMA QA Coordinator is responsible for providing comments to data generators and the DEQ 305(b) Coordinator concerning the acceptability of SOPs and QA/QC documentation for chemical data.

If a chemical, biological or tidal waters data package cannot be used in the assessment process, the appropriate DEQ staff will provide the data generator an explanation for the data not being directly useable. A list of all data providers and the status of the QA/QC review will be included in Appendix D of the 2010 Integrated Report.

PART II WATER QUALITY MONITORING, INFORMATION AND RESTORATION ACT (WQMIRA)

In 1997, the General Assembly enacted the Water Quality Monitoring, Information and Restoration Act (WQMIRA) §62.1- 44.19:4 through §62.1- 44.19:8. This legislation supplements the CWA 305(b)/303(d) federal requirements. The requirements of this legislation for State assessment procedures or processes are briefly outlined as follows:

1. The Act requires the 303(d) portion of the Integrated Report to identify geographically defined water segments as impaired if monitoring or other evidence shows:

    a. violations of ambient WQ Standards for aquatic life or human health;
    b. fishing restrictions or advisories;
    c. shellfish consumption restrictions due to contamination;
    d. nutrient over-enrichment;
    e. significant declines in aquatic life biodiversity or populations; and/or
    f. contamination of sediment at levels which violate WQ Standards or threaten aquatic life or human health.

2. Waters identified as "naturally impaired", "fully supporting but threatened" or "evaluated" (without monitoring) as impaired shall be set out in the 303(d) portion of the Integrated Report in the same format as those listed as "impaired".

3. The 303(d) portion of the Integrated Report shall include an assessment, conducted in conjunction with other appropriate state agencies, for the attribution of impairment to point and nonpoint sources. The absence of point source permit violations on or near the impaired water shall not conclusively support a determination that impairment is due to nonpoint sources. In determining the cause for impairment, the Board shall consider the cumulative impact of 1.) multiple point source discharges, 2.) individual discharges over time, and 3.) nonpoint sources.

4. The Board shall develop and publish a procedure governing its process for defining and determining impaired water segments and shall provide for public comment on the procedure.

5. The Integrated Report, inclusive of CWA sections 305(b) and 303(d) shall be produced in accordance with the schedule required by federal law and shall incorporate at least the preceding five years of data, where appropriate. Data older than five years shall be incorporated when scientifically appropriate for trend analysis or other longer term considerations.

6. The Integrated Report, inclusive of CWA sections 305(b) and 303(d), shall be developed in consultation with scientists from state universities prior to submission by the Board to EPA.

7. The Integrated Report, inclusive of CWA sections 305(b) and 303(d), shall indicate water quality trends for specific, easily identifiable, geographically defined water segments and provide summaries of the trends using available data and evaluations. This will allow the citizens of the Commonwealth to easily interpret and understand the conditions of the geographically defined water segments.

8. Based on the information in the Integrated Report, inclusive of CWA sections 303(d) and 305(b), the Board shall request the Department of Game and Inland Fisheries (DGIF) or the Virginia Marine Resources Commission (VMRC) to post notices at public access points for all "toxic" impaired waters. The notice, prepared by the Board, shall contain the basis for the impaired designation and a statement

of potential health risks. The Board shall coordinate with the DGIF and VMRC to assure that adequate notice of posted waters is provided to those purchasing hunting and fishing licenses.

PART III RULES FOR THE 2010 WATER QUALITY ASSESSMENT

Rule 1

Impaired waters are defined as those with chronic, recurring or human health related WQ Standard exceedences using QA/QC approved ambient monitoring data, special study data and/or other programmatic in-stream data collections. Predictive data generally refers to computer generated modeling data and may be used for assessment purposes on a case by case basis. Impaired waters are generally based on exceedences of the numeric WQ Standards criteria using the guidelines described in Part V and VI of this guidance and/or exceeding the narrative WQ Standards.

Unless otherwise specified, Rule 1 applies to the conventional parameters dissolved oxygen, pH, bacteria, and temperature (except temperature in tidal waters) and in some cases, nutrients. Previous EPA guidance recommended States use a violation rate of > 10.5% of the total samples analyzed for classifying waters impaired due to potential monitoring equipment malfunctions and data analysis errors. However, a single sample will not be assessed and will be placed in federal Category 3 (Insufficient Data). Additionally, a single exceedence of the WQ Standards results in an assessment of insufficient data for small datasets (2-9 samples) of conventional parameters. At least two exceedences and > 10.5% of the total samples is required before a water is listed as impaired. This includes small datasets. Temperature in tidal waters up to the fall line will not be assessed due to the lack of a maximum WQ Standard for temperature in these waters.

Rule 2

Waters classified as impaired based on biological data or restrictions placed on the designated uses (shellfishing and fish consumption advisories, limiting consumption) by the Virginia Department of Health (VDH), are in violation of the narrative Designated Use Standard (9 VAC 25–260–10 A.) unless the designated use has been administratively removed due to the presence of a permitted discharge outfall and any associated VDH safety zone, areas deemed not productive enough for harvest primarily due to salinity variations in transition zones or a consumption advisory that does not limit the designated use.

Rule 3

For recreational designated use, E.coli (freshwater) and enterococci (saltwater and transition zone) data will be assessed. Fecal coliform will not be assessed for 2010. Any previous listings for fecal coliform will remain as impaired until appropriate bacteria data is available and assessed.

The E coli/enterococci instantaneous maximum standard of 235 per 100 ml (E. coli in fresh water) and 104 per 100 ml (enterococci in saltwater and transition zone) applies when a minimum of 4 weekly samples per month are not available to calculate a geometric mean. Where data are not sufficient to calculate a monthly geometric mean, at least two exceedences and >10.5% of the total samples taken during the assessment period exceeding the instantaneous maximum bacteria Standard for primary contact recreation is impaired.

When appropriate, the monthly geometric mean standard of 126 per 100 ml (E. coli) for freshwater and 35 per 100 ml (enterococci) for saltwater and transition zone applies where a minimum of 4 weekly samples are collected during any calendar month. See 9 VAC 25-260-140-C for fresh water, saltwater

and transition zone delineation. Two or more monthly geometric mean exceedences results in an impairment.

Rule 4

Conventional parameter data, generated by probabilistic monitoring (Probmon) networks, will be used as a "general overview" of those waters and shall be used to direct additional targeted monitoring into those areas that indicate potential water quality degradation. This is due to the fact that, for most stations, only one data point will be available from probabilistic monitoring and an assessment for the associated parameters will not be made on one data point unless that data point exceeds a human health standard. A single "grab sample" exceedence of human health or aquatic life toxic criteria is assessed as fully supporting with an observed effect and follow-up monitoring should be conducted within a 3-year period to determine if the water is impaired. A single chronic or acute exceedence of a 30-day semi-permeable membrane device (SPMD) sample for a toxic parameter associated with aquatic life and wildlife use is considered fully supporting with an observed effect. A single fish tissue, 30 day SPMD sample or sediment sample with no exceedence is considered fully supporting the associated use because these types of samples are generally associated with longer-term water quality conditions. For probabilistic stations with 2 conventional data points, assessment will be the same as any station with 2 or more data points. Benthic data will be compared to the Virginia Stream Condition Index (VSCI) or Coastal Plain Macroinvertebrate Index (CPMI) and assessed accordingly.

Rule 5

When assessing multiple sample data or continuous sampling data, as with a multi-probe, the 24 hour "daily average" will be used, as appropriate, for assessment of the daily Standard. Where appropriate, this rule does not apply to depth profile sampling where each depth sample should be assessed as an independent sample. The Chesapeake Bay and its tidal tributaries will be assessed according to the Chesapeake Bay designated uses and corresponding criteria.

Rule 6

When data analysis reveals fully supporting with observed effects or insufficient data but having observed effects, additional monitoring relating to the designated use associated with the observed effect should be considered. Observed effects are water quality observations where WQ Standards have not been exceeded due to the lack of a Standard or criteria and/or lower quality and less reliable data indicates potential adverse water quality associated with a particular designated use. This rule applies to conventional and toxic parameters (water column, sediment, nutrient and fish tissue) as well as biological monitoring.

Rule 7

Waters that are assessed as impaired and suspected to be naturally occurring, non-anthropogenic (not human related) conditions (such as low DO and/or pH in slow-flowing Class VII (swamp) waters or high temperature from thermal springs) will be included in Category 5C (possibly needing a TMDL) of the Integrated Report. If natural conditions are shown to be responsible for the impairment, the water will then be listed in Category 4C (impaired but not needing a TMDL). For waters in Category 5C or 4C, the WQ Standards will be reviewed and possibly updated during next triennial review to reflect variations caused by natural conditions for these waters. Once appropriate WQ Standards are in place, data will be reviewed again to determine whether these waters meet or exceed designated uses. It may be necessary to conduct a TMDL study or Use Attainability Analysis (UAA) prior to WQ Standards modification in order to determine and/or verify the appropriate criteria based on natural pollutant loadings.

Until such time that a study has been conducted that establishes the natural dissolved oxygen level(s) for a specific Class VII water, and monitoring confirms that there are no exceedences, such water may not be classified as in attainment. However, such a study is not required until either nutrient levels, land use changes, new point sources, or other potential anthropogenic causes and/or sources are occurring that could affect water quality. Once a dissolved oxygen criterion is established for a Class VII swamp water, adequate monitoring will be conducted to determine attainment or non-attainment for dissolved oxygen criteria and the water may be reclassified in the next water quality assessment.

Rule 8

Waters that were fully supporting or on previous 303(d) lists, with no additional monitoring data for the reporting period, will continue to be tracked in the Integrated Assessment Database (ADB) and monitoring station list. These waters will retain the results of the previous assessment for all designated uses. For those waters on a previous 303(d) list, they will continue to be tracked until a TMDL is developed or additional monitoring data and assessment reveals the waters are no longer impaired and needing a TMDL for the designated use(s) for which it was originally listed and EPA approved for delisting. As previously stated, this rule applies to those waters that were originally found to be fully supporting designated use(s) and no additional monitoring data has been collected to generate a new assessment. However, due to the ambient monitoring watershed rotating approach, fully supporting waters can only be carried forward as fully supporting for two additional reporting cycles with no new data. After two reporting cycles, if no additional data has been collected the water will be listed as insufficient information and will remain in that category until new data is collected and assessed.

Rule 9

For effluent limited waters, if the VPDES permit has been issued with a scheduled compliance date that extends beyond the next 303(d) listing or permit cycle, the water would be listed as Category 5E. If the compliance date falls within the next listing cycle or within the current permit cycle whichever is longer, the water would be listed in Category 4B. See Section 7.1 for additional information.

Rule 10

Duplicate and/or split samples collected for QA/QC purposes will not be used in the assessment. The primary sample (S1) will be assessed against the appropriate Standard and the duplicate/split sample (S2) will be used only to document lab analysis quality control.

Rule 11

In assessing water quality trends, a segment will be classified as threatened if the trend predicts a WQ Standard criteria exceedence by the next assessment reporting period. A trend analysis will be conducted every six years.

Rule 12

Sampling stations that happen to be located within a permitted mixing zone, primarily via probabilistic monitoring, will not be individually assessed for aquatic life use. They will be included with the overall probabilistic assessment. Any other stations that inadvertently were located in mixing zones will not be assessed individually for aquatic life use as the use is exempt in mixing zones.

Rule 13

A review of stockable and some natural trout waters currently listed as impaired has revealed that many of these impairments are due to erroneous segment boundaries or natural conditions. Both issues were addressed as part of Virginia's recently EPA approved Triennial Review. For the 2010 assessment, these waters will be categorized as category 2A if specifically addressed via Standards and currently meeting new criteria or 4C (impaired due to natural conditions and not needing a TMDL) as long as supporting documentation is provided by the Virginia Department of Game and Inland Fisheries (VDGIF) and endangered species are not being adversely affected. This should prevent and/or correct the misclassification of these segments, pending any additional Triennial Review adjustment. Once these Standard reviews are completed and EPA approved, these waters will be re-evaluated and classified accordingly.

Rule 14

Multi-probe meters are accurate to single digits (tenths) and data associated with these monitoring devices are truncated to single digits.

Rule 15

Nested impairments are those waters that are included in a watershed TMDL. The watershed TMDL incorporates multiple waters that make up a larger watershed. The TMDL requires a specific loading reduction for all waters within the watershed whether they currently meet the Standard or not. Once the TMDL reduction allocations are EPA approved, any waters within the watershed that are subsequently assessed as impaired for that same designated use and cause will be considered Category 4A (impaired and not needing a TMDL). In order to show progress, those waters that are impaired and subsequently meet Standards will be delisted from Category 4A. Nested impairments are normally bacteria related to primary contact and shellfish consumption uses but may also include benthic impairment (aquatic life use) depending on the stressors involved.

Rule 16

Division of Consolidated Laboratories (DCLS) has determined that total dissolved ammonia and total ammonia are essentially the same thing. Thus, where only dissolved ammonia data are available, these will be used to assess against the total ammonia criteria. Where both data are available, total ammonia should be used to assess the criteria.

Rule 17

Shellfish waters where restrictions or prohibitions are due solely to a discharge outfall and associated buffer zone or where the use is deemed too limited to harvest due to low salinity or other natural reasons, and not due to water quality exceedences will not be included in the 303(d) list. In these cases, monitoring should not be conducted as the shellfish designated use has been administratively removed through the issuance of a discharge permit or prohibition on harvesting

PART IV DESIGNATED USES of VIRGINIA'S WATERS

The 305(b) process assesses a total of six primary designated uses, as appropriate for a particular waterbody, based on the WQ Standards. Assessed designated uses may include wildlife use, aquatic life use, swimming use, fish consumption use, shellfish consumption use and drinking water use. Swimming use is assessed to represent the primary and secondary water contact recreational use. Drinking water use, where applicable, is based on attainment of public water supply criteria. The Chesapeake Bay criteria, adopted in 2005, have sub-divided the

aquatic life use into several distinct sub-uses. See Section 6.4.2.1 for additional information relative to the new Chesapeake Bay criteria. Following are details relating to the assessment of the six designated uses of Virginia's waters.

1. Wildlife Use:

Wildlife use includes the propagation, growth, and protection of a balanced, indigenous population of wildlife.

Support of wildlife use is determined by assessing Water Quality Toxic Standards for aquatic life found in 9 VAC-25-260-140 B. These criteria were developed to protect aquatic life as well as wildlife.

2. Aquatic Life Use:

Aquatic life use includes the propagation, growth, and protection of a balanced indigenous population of aquatic life (including game and marketable fish) which may be expected to inhabit the waters.

Support of aquatic life use can be determined by the assessment of conventional parameters (dissolved oxygen, pH and temperature), toxic pollutants in the water column (relative to the acute WQ Standards), toxic pollutant analysis of sediments, toxicity testing, nutrient analysis and/or the biological assessment of benthic communities. All available data, relative to aquatic life use, shall be considered to determine if the aquatic life use is being supported. This assessment includes the sub-categories of aquatic life use associated with the Chesapeake Bay criteria. The maximum temperature will not be assessed for aquatic life in tidal waters as no maximum temperature Standard is applicable.

3. Fish Consumption Use:

Fish consumption use includes the propagation, growth and protection of a balanced population of aquatic life including game and marketable fish. Human health is also a primary consideration with regard to fish consumption use.

Support of this use is determined using three separate criteria. First, support or lack thereof, is based on human health related advisories and/or restrictions issued by the Virginia Department of Health (VDH). Impairment for fish consumption results when the public is advised by VDH that fish consumption is prohibited for the general population or an advisory that certain fish species should not be consumed by the general population or sub-populations at greater risk, such as children and/or pregnant women.

Second, the assessment methodology used for fish consumption use is a comparison of fish tissue data to WQ Standards criterion based tissue values (TVs) and tissue screening values (TSVs) for toxic pollutants. Any single observation above the TV or TSV results in the water being assessed as fully supporting but having an observed effect. Two or more exceedences of a particular TV listed in Appendix E-1 results in an impaired assessment of the water for the fish consumption designated use.

Third, support of the fish consumption use is determined by comparison to the human health criteria in public water supplies and other surface waters, as listed in the WQ Standards (9 VAC-25-260-140 B).

4. Shellfish Consumption Use:

Shellfish consumption use includes the propagation, growth and protection of a balanced population of aquatic life including marketable shellfish. Support of this use is determined using the following criteria. The Division of Shellfish Sanitation (DSS) of the VDH bases support or lack thereof on a classification system designed for the harvesting and marketing of shellfish resources in accordance with Food and Drug Administration (FDA) guidelines. Four classifications are used to describe shellfish waters. They are approved, conditionally approved, restricted, and prohibited. ***Approved*** areas are waters from which shellfish may be taken for direct marketing at all times. ***Conditionally approved*** (seasonal condemnation) areas are waters where the quality may be affected by a seasonal population increase or sporadic use of a dock or harbor facility. ***Restricted*** (condemnations) areas are waters where a sanitary survey indicates a limited degree of pollution which makes it

unsafe to market shellfish for immediate consumption. Shellfish harvested in these areas must be moved to an approved area for a certain length of time to allow for depuration before marketing. ***Prohibited*** (condemnations) areas are waters where the DSS sanitary survey indicates dangerous numbers of pathogenic microorganisms or other contaminants to impact the area. Shellfish cannot be harvested or relayed for purification in prohibited areas.

Additional information relative to shellfish use assessment can be found in Appendix C of this guidance.

5. Recreation/Swimming Use:

Recreation use assessment includes swimming and other primary and secondary water contact recreation uses such as water skiing and pleasure boating.

Normally, support or lack thereof of this use is based on a comparison of E. coli and enterococci bacteria data to the instantaneous standard using the > 10.5% percent assessment method. However, if a special study, designed to collect at least 4 weekly bacteria data points within a calendar month, is conducted, such as in the BEACH (Beaches Environmental and Coastal Health) program, then these results should be compared to the geometric mean criterion described in 9 VAC-25-260-170. Additionally, any VDH beach closures/swimming advisories should be assessed according to Part V.

6. Public Water Supply Use:

Waters that are used for public drinking water supply are identified in the WQ Standards and are protected by additional health related standards that are applicable to these waters. Support or lack thereof of this use is based on VDH closures or advisories due to excessive pollutant(s) and/or a comparison of water column data to applicable public water supply criteria. Table 1 is a summary of the designated uses and the criteria used to assess the individual uses.

Table 1 DESIGNATED USE MATRIX

NO.	DESIGNATED USE	SUPPORT OF USE ASSESSMENT CRITERIA
1.	Wildlife Use	Aquatic life toxics criteria in the water column
2.	Aquatic Life Use	Conventional parameters (DO, pH, Temp.); Aquatic life toxics criteria in water column (relative to the acute WQ Standards); toxicity testing; biological evaluation. Waters exceeding sediment screening values (SVs) or toxicity tests are considered to have "observed effects".
3.	Fish Consumption Use	Consumption advisories, limiting consumption, or restrictions issued by VDH; Comparison of fish tissue data to WQ Standards criterion based tissue values (TVs) for toxic pollutants found in Appendix E-1 and tissue screening values (TSVs) found in Appendix E-2.
4.	Shellfish Consumption Use	Restrictive actions that are based on monitored bacteria data for harvesting and marketing of shellfish resources made by Div. of Shellfish Sanitation of VDH.
5.	Recreation/Swimming Use	Conventional Pollutant (E. coli and enterococci bacteria) and/or VDH beach closures/advisories or other available bacteria data. Previously listed fecal coliform impairments with no additional conventional bacteria data.
6.	Public Water Supply Use	VDH closures or advisories due to excessive pollutant(s); comparison of data to applicable public water supply standards.

PART V CRITERIA TO DETERMINE DEGREE OF USE SUPPORT

Virginia bases its water quality assessment on the ability of the waters to support the associated designated uses. Support is based on the waters meeting the criteria for each use based on the numeric and/or narrative WQ Standards. The following is a description of the criteria used to determine the quality of the waters relating to each of the designated uses, and thereby the degree of use support that will be presented in the Integrated Report. Waters where no water quality data exist for any designated use(s) are categorized as insufficient data (Category 3).

1. Not Assessed

Waters with no data for any uses or a single sample (conventional data only) relative to aquatic life will not be assessed (Category 3A). Additionally, waters where a designated use has been administratively removed due to other legal restrictions or condemnations and not due to water quality conditions.

2. Insufficient Information

Waters that have a single exceedence in a small dataset (2-9 samples) are considered insufficient data (Category 3B). Additionally, data that is older than six years and does not reflect the current water quality are considered insufficient. Waters that have been previously listed and needing a TMDL will remain listed until a TMDL is completed or additional data is collected and assessed. Waters, where the data are not QA/QC approved but the data review indicate potential degradation, are categorized insufficient but having observed effects (Category 3C). Waters where the data are not QA/QC approved but the assessment results indicate acceptable water quality will be considered insufficient data with no observed effects (Category 3D).

3. Fully Supporting

The following is a description of the types of data and the acceptable criteria used to assess waters as fully supporting designated uses. These waters would be placed in the Category 2A or 2C unless all designated uses are fully supporting, upon which the water would be placed in Category 1.

- *Conventional/Bacteria Parameters*:

Waters fully supporting designated uses can have up to 10.5% exceedences of WQ Standards for the parameters E.coli or enterococci bacteria, (recreation use) and the conventional parameters dissolved oxygen, temperature and pH (aquatic life use) without negatively affecting designated uses. This criterion is based on natural variables or analytical errors which DEQ acknowledges can produce exceedences of these criteria in the 0-10.5% range. All data assessed as fully supporting must be QA/QC approved.

The WQ Standards (9 VAC 25-260-50) criteria for D.O., pH and Temperature do **not** apply (7Q10).
7Q10 is the lowest flow averaged (arithmetic mean) over a period of seven consecutive days that can be statistically expected to occur once every 10 climatic years (a climatic year begins April 1 and ends March 31). Data for these parameters that are from flow conditions below 7Q10 will not be used in the Integrated Report.

- *Toxic Pollutants:*

For toxic pollutant assessment in free-flowing streams, waters where there are one or more samples and no exceedences of aquatic life criteria within a running 3-year period, using grab samples or SPMD data, are considered fully supporting for aquatic life and wildlife use. For public water supply and human health related criteria in other surface waters, one or more samples and no exceedences during the reporting period, using grab samples or SPMD data, are considered fully supporting for PWS and/or fish consumption use. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3.

For toxic pollutant assessment in estuarine waters, where there are several types of toxic data available, a weight of evidence approach has been initiated. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3

- *Fish Tissue/Sediment Contamination*

One or more samples recording no exceedences of a fish tissue Water Quality Standard TV or TSV found in Appendix E-1 or E-2 or sediment screening values (SVs) found in Appendix F are considered fully supporting.

- *Biological Evaluation*:

For free-flowing stream benthic macroinvertebrate assessments, data for the overall assessment period is rated as not impaired where the new Virginia Stream Condition Index (VSCI) or the Coastal Plain Macroinvertebrate Index (CPMI) scores are at or above their respective impairment thresholds. (60 for the VSCI or 16 for the CPMI)

A project to refine the estuarine biological assessment methodology (B-IBI) was completed in 2006 and approved for use by EPA. The same methodology will be used again for 2010. See Section 6.4.2.2 for additional information.

- *Shellfish Advisories*:

Those growing areas where no restriction or prohibition (condemnation) on shellfish harvesting, based on sampling data, is imposed as indicated by the Department of Shellfish Sanitation (DSS) summary dated January, 2009. Additional information on shellfish assessment and consumption use is contained in Part VI, Section 6.4.4 as well as Appendix C.

- *Beach Closures/Advisories:*

No VDH beach closures and/or geometric mean exceedences, based on QA/QC approved sampling data, during the assessment period.

- *Public Water Supply Source Closures:*

No VDH public water supply source closures based on sampling data during the assessment period.

4. <u>Fully Supporting but Having an Observed Effect</u>

The following is a description of the types of data and the acceptable criteria used to assess waters as fully supporting but having an observed effect for a designated use(s). <u>It is the intent of the agency to focus additional monitoring resources on the waters that are identified as having an observed effect, based on initial monitoring data analysis.</u> These waters would be placed in the federal Category 2 and the Virginia Subcategory of 2B or 3B.

- *Conventional Screening Parameters*:

Waters that have or 1 or more exceedences for sediment and/or toxicity test are considered fully supporting but having an observed effect for aquatic life use due to the lack of a Water Quality criterion for these parameters (Category 2B).

- *Toxic Pollutants:*

For toxic pollutant assessment in free-flowing streams, a single exceedence of aquatic life criteria within a 3-year period, using grab samples or SPMD data, is considered fully supporting but having an observed effect for aquatic life and wildlife. For public water supply use or human health criteria in other surface waters, a single exceedence is considered fully supporting but having an observed effect for PWS and/or fish consumption use.

For toxic pollutant assessment in estuarine waters, where there are several types of toxic data available, a "weight of evidence" approach has been initiated. If no additional toxic data is available, the water would be assessed the same as the free-flowing waters. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3.

- *Fish Tissue/Sediment Contamination:*

Waters with a single exceedence of a WQ Standards based TV or TSV found in Appendix E-1 or E-2 from one or more samples for fish tissue or SPMD, or an exceedence of a SV for sediment found in Appendix F, are fully supporting but having an observed effect for fish consumption and aquatic life, respectively.

- *Biological Evaluation*:

For free-flowing streams, benthic macroinvertebrate data for the assessment period with VSCI or CPMI scores below the impairment threshold should be considered fully supporting but having an observed effect where the biologist has observed natural conditions such as recent drought or flooding, etc. that could be responsible for lowering the assessment score. For waters assessed as fully supporting but having an observed effect for aquatic life use, it is necessary for another biological assessment to be scheduled to make a final aquatic life use determination. Additional information can be found in Part VI Section 6.4.1.

A project to refine the estuarine (B-IBI) biological assessment methodology was completed in 2006 and accepted for use by EPA. The same methodology will be used for 2010. See Section 6.4.2.2 for additional information.

- *Fish Advisories:*

A VDH fish consumption advisory, where a general advisory has been issued but fish consumption is not limited, are considered fully supporting but having an observed effect.

- *Shellfish Advisories:*

Those growing areas, as indicated by the DSS summary dated January, 2009, that have been classified as conditionally approved (seasonal condemnations) are considered fully supporting but having an observed effect unless they fall within a water quality related condemnation area. Normally, in these cases, the seasonal condemnation would be included in the water quality related condemnation. Additional information on shellfish assessment and consumption use is contained in Part VI, Section 6.4.4 and Appendix C.

- *Beach Closures/Advisories*:

One short term (less than one week in duration) beach closure and/or two short term (less than one week in duration) swimming advisories due to bacteria contamination, and based on QA/QC approved data within the 6 year assessment cycle with a low probability that the pollution will recur (based on best professional judgment) is considered fully supporting with observed effects. Best professional judgment decisions will be based on scientific data indicating the source of the pollution causing the closure/advisory is transient and there are no plans to implement pollution reduction measures or other controls, or documentation shows that mitigation has occurred and the two most recent years of water quality data, subsequent to the mitigation, show an improvement that fully supports the designated use.

- *Public Water Supply Source Closure:*

One, short term, VDH public water supply source closure during the 6 year assessment cycle with a low probability that the pollution will recur is considered fully supporting but having an observed effect. The source of the pollution is generally transient and there are no VDH plans to implement pollution reduction measures or other controls.

- *Other Criteria for Waters having Observed Effects*

Waters for which "evaluated" data, trend analysis for parameters with no WQ Standards but with screening criteria, or other water quality indicators appear to indicate an apparent effect on designated use(s) or a potential for water quality problems are considered to have "observed effects". Waters can be designated as having observed effects where there is a possible loss of a designated use documented by ancillary data such as fish kills with unknown causes and/or pollution potential documented by non-QA/QC approved studies or reports. These waters are considered insufficient data with observed effects (Category 3C). For monitoring purposes, waters with observed effects should be considered in the next regional monitoring plan for continued monitoring during the next reporting period as resources allow.

5. **Pollutant Caused Impaired Waters Not Needing a TMDL**

Impaired or threatened waters not needing a TMDL are those waters that are listed in the federal Category 4. These are waters that are impaired but an EPA approved TMDL has been developed (Category 4A), other "alternative control" requirements are reasonably expected to result in attainment of designated use(s) (Category 4B), waters that are naturally impaired (Category 4C) and waters that are impaired for the same pollutant and nested within an approved watershed TMDL (Category 4A).

6. Pollutant Caused Impaired Waters Needing a TMDL

The following is a description of the types of QA/QC approved data and the acceptable criteria used to assess waters as impaired or threatened for the designated uses. Those waters impaired by pollutant(s) and needing a TMDL are included in the 303(d) list. These waters are placed in the federal Category 5 (needing a TMDL) and the Virginia sub-categories of 5A, 5B, 5D and possibly 5C and 5E.

- *Conventional Parameters*:

Waters with long term or chronic pollutant related problems based on the assessment of monitored data are considered impaired and needing a TMDL. For conventional parameters, at least two exceedences of WQ Standards and exceedences >10.5% are considered long term or chronic problems and generally are considered impaired and needing a TMDL. Additionally, waters with 2 or more exceedences of a monthly geometric mean are considered impaired. These geometric mean analysis are normally associated with the BEACH monitoring program conducted by VDH but also could be associated with a designed, multiple sample per month, bacteria special study.

- *Toxic Pollutants:*

For toxic pollutant assessment in free-flowing streams, waters where there are 2 or more exceedences of the same WQ Standards acute aquatic life toxic criteria in a running 3-year period using grab samples or SPMD data are considered impaired for aquatic life use and wildlife use. For public water supply or human health criteria in other surface waters, 2 or more exceedences of the same criteria within the reporting period using grab samples or SPMD data are considered impaired and needing a TMDL for PWS and/or fish consumption use.

For toxic pollutant assessment in estuarine waters, where there are several types of toxic data available, a "weight of evidence" approach has been initiated. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3.

- *Fish Tissue Contamination:*

Waters exceeding the same toxic human health criteria based tissue value (TV) listed in Appendix E-1, 2 or more times are impaired for fish consumption. For example, the following situations would qualify as impaired under these guidelines. Two or more tissue samples from different fish species exceeding the same TV during one sampling event or two or more samples of the same or different species exceeding the same TV from different sampling events within the assessment period are considered impaired.

- *Biological Data*:

Free-flowing streams where the VSCI or CPMI scores are below the impairment threshold are considered impaired and needing a TMDL.

A project to refine the estuarine biological assessment methodology was completed in 2006 and accepted for use by EPA. The same methodology will be used for 2010. See Section 6.4.2.2 for additional information.

- *Fish Advisories:*

Virginia Department of Health (VDH) fish consumption prohibitions and/or advisories, where fish consumption is specifically limited due to contamination, are considered to be in non-attainment of the fish consumption designated use and considered impaired and needing a TMDL.

- *Shellfish Advisories*:

Those growing areas, as indicated by the DSS summary dated January, 2009, that have been classified as prohibited or restricted (condemnations) based on water quality are considered impaired and needing a TMDL. Restricted areas that have been administratively condemned due solely to the presence of a VPDES permitted outfall or other administrative closure where no data is available will not be assessed as the shellfish use is considered removed. Additional information on shellfish assessment and consumption use is contained in Part VI, Section 6.4.4 and Appendix C.

- *Beach Closures/Advisories:*

A beach is considered impaired if >10.5% of single sample exceedences, two or more monthly geometric mean exceedences or one or more beach closures of one-week or more duration due to contamination or two or more swimming advisories of one week or more duration due to contamination and based on QA/QC approved data within the assessment cycle with a medium to high probability that the closure/advisory will recur (based on best professional judgment). There are no plans to implement pollution reduction measures or controls nor have any plans been implemented.

- *Public Water Supply Source Closure*:

One or more VDH public water supply source closures due to contamination within the assessment cycle with a medium to high probability that the contamination will recur are considered impaired and needing a TMDL. Additionally, there are plans to implement pollution reduction measures or controls.

Table 2 summarizes the designated use assessment criteria.

Table 2 Designated Use Assessment Criteria

	Fully Supporting **Category 1, 1A, 2A, or 2C**	**Fully Supporting or Insufficient data but Having Observed Effects** **Category 2B or 3C**	**Impaired or Threatened Waters Needing a TMDL** **Category 5A,5B,5C, 5D or 5F** **(Impaired with TMDL Approved = Category 4A)**
Conventional Parameters Aquatic Life Use Support (ALUS) and Recreational Use (temperature will not be assessed in tidal waters)	2 or more samples and AR ≤10.5%	**Non QA/QC approved** with exceedences > 10.5% And 2 or more exceedences in a small dataset (2-9 samples)	2 or more exceedences and AR > 10.5% of total samples
Toxic Pollutants in Water Column and/or Sediment Aquatic Life Use Support (ALUS) and Wildlife Use	One or more samples and no exceedences	A single grab or SPMD sample exceedence of a acute aquatic life criteria or 1 or more grab sample exceedences of same chronic aquatic life criteria in a 3 year period (water column only) (ALUS & Wildlife) One or more toxicity test or SV exceedence (sediment only) (ALUS)	2 or more grab sample or SPMD exceedences of the same acute aquatic life criteria in a 3-yr period (water column only) (ALUS & Wildlife) Failing the "weight of evidence" toxicity evaluation (Section 6.5.3)
Toxic Pollutants related to human health, (PWS, & Fish Consumption)	One or more samples and no exceedences	A single exceedence of a human health criteria using grab sample or SPMD data (PWS and/or fish consumption) A single exceedence of any toxic WQS TV or TSV, listed in Appendix E-1 or E-2 (fish consumption)	2 or more exceedences of the same human health criteria using grab samples or SPMD data (PWS and/or fish consumption) 2 or more exceedences of the same toxic WQS TV, listed in Appendix E-1 (fish consumption)
Biological Data	Freshwater: VSCI or CPMI assessment scores at or above the impairment threshold Estuarine: Not Impaired	Freshwater: VSCI or CPMI assessment scores below the impairment threshold where biologist's best professional judgment has determined a lack of confidence in the biological survey due to natural conditions Estuarine: See Section 6.4.2.2 for additional information.	Freshwater: VSCI or CPMI assessment scores below the impairment threshold Estuarine: See Section 6.4.2.2 for additional information.
Fish Consumption Advisories or Restrictions	No exceedences of fish tissue criteria	A VDH advisory which does not limit consumption is in effect	A VDH advisory or restriction limiting or prohibiting consumption is in effect
Shellfish Advisories	Approved shellfish harvest waters	Area classified as Conditionally Approved (seasonal condemnations) and not included in a restricted or prohibited area	All areas classified as Restricted or Prohibited: Excluding VPDES outfalls and administrative closures where the use has been removed and no data is available
Recreation Use (see Conventional Parameter criteria) and Beach Closures/Advisories	No geometric mean exceedences or beach closure/advisory	No geometric mean exceedence and one short term (< 1 week) closure/advisory due to QA/QC approved bacteria data with low probability of recurrence (pollution source transient)	>10.5% single sample exceedences, two or more exceedences of a geometric mean and/or 1 or more closure and/or 2 or more advisories > 1 week duration due to QA/QC approved bacteria data with medium or high probability of recurrence
Public Water Supply (PWS) Source Closures	No closures based on sampling data	One VDH closure based on QA/QC approved data with low probability of recurrence	One or more VDH closure based on QA/QC approved data with medium or high probability of recurrence

AR = arithmetic exceedence rate
SV = screening value
ALUS = Aquatic Life Use Support
PWS = Public Water Supply

PART VI ASSESSMENT METHODOLOGY

Section 6.1 CONVENTIONAL PARAMETER METHODOLOGY

State and federal law requires DEQ to produce a biennial report on the condition of its waters to Virginia's citizens and the EPA. The waters are evaluated in terms of whether the appropriate designated uses are met (9-VAC 25-260-10). These uses are: 1) wildlife, 2) aquatic life, 3) fish consumption, 4) shellfish consumption, 5) swimming (primary and secondary contact recreation) and 6) drinking water use. Additionally, there are sub-categories of aquatic life use associated with the Chesapeake Bay Standards. DEQ employs the "Percent Method" to assess conventional pollutant impacts in waters for two uses: aquatic life use and swimming use.

6.1.1 Description of the Fixed Rate (Percent) Method

As with previous assessments, DEQ uses the percent method which is based on assumptions about the kind and frequency of data needed to support such an assessment. The objective of this method is to indicate whether waters are fully supporting or impaired for the designated uses and ultimately for the assessment unit (AU). A 10.5% exceedence threshold is used for determining full support or impairment for conventional pollutants. An exceedence rate that is > 10.5% with at least 2 exceedences is normally considered impaired. An exceedence rate ≤ 10.5% is considered fully supporting. A single exceedence in a small dataset (2-9 samples) is considered insufficient to indicate fully supporting or impaired.

In effect, the fixed rate assessment guidelines imply that an exceedence of a conventional numeric criterion in 10.5% or less of the samples taken does not impair the aquatic life designated use due to many variables associated with sampling errors and/or weather factors that can cause periodic exceedences but not affect the overall designated use. The rule of thumb is described in Table 3.

Table 3 Fixed Rate Assessment Guidelines

Violation Rate (AR) of Total Samples Analyzed	Assessment
AR ≤10.5%	Meets use (Category 2A, 2B or 2C)
AR > 10.5%	Fails to meet use (impaired) Categories 4A, 5A, 5B, 5C or 5D

In recent years, DEQ has been encouraged to spread its monitoring efforts over more of the State's waters. To achieve this goal with a fixed monitoring budget, the average collection frequency changed from monthly to bimonthly. This monitoring frequency has been applied to a rotating watershed scheme with 1/3 of the watersheds being monitored for a 2-year cycle with all watersheds being monitored within 6 years. The benefit from this change is that more streams and more stream miles can be assessed. The disadvantage is that the data collected from each station are fewer (12 samples/2 years). The data set has become wide geographically but shallow in frequency. This aspect somewhat concerns DEQ in that the fixed rate method assumptions are based on a monthly sampling frequency. Additional monitoring program review and possible monitoring strategy update stems from the need for additional monitoring data for Total Maximum Daily Load (TMDL) development.

Section 6.2 MONITORING STATION DELINEATION AND SITING METHODOLOGY

6.2.1 Monitoring Station Delineation

DEQ has a vast network of active Ambient Water Quality Monitoring (AWQM) stations and a number of biological stations statewide. The AWQM stations are generally monitored bimonthly while the biological stations are normally monitored twice a year (usually in the spring and fall). Monitoring programs can be designed based on a "source targeted" (conventional) approach or a "probability based" approach or a combination of the two. Each monitoring program design has its advantages and disadvantages. Historically, most of DEQ's monitoring strategy has been based on the conventional approach. Many of the stations were located in proximity to (above and below) Virginia Pollutant Discharge Elimination System (VPDES) facility

outfalls. During this reporting cycle, DEQ has continued to use a rotating watershed approach where stations are sited for 2 years of bimonthly sampling. The number of stations per watershed is based on the drainage area of the watershed and the Department of Conservation and Recreation (DCR) "nonpoint source potential" rating of the watershed. In order to provide consistency between the regional planning staff and to get an accurate number of assessed stream miles in Virginia, the following stream delineation guidelines are the primary considerations used in the assessment unit (segment) size decisions. However, in certain cases, best professional judgment of the regional staff may be used if the delineation results are contrary to these guidelines. Where appropriate, documentation of these best professional judgment decisions should be included in the segment narrative.

1. Typically, no more than 10 miles of free-flowing stream should be assessed by the conventional pollutant data from one ambient monitoring station. Miles assessed for a toxic pollutant or biological impairment may vary from the miles assessed for conventional parameters.

2. One monitoring station should not be used to assess an entire watershed unless land use, source, and habitat are relatively homogeneous.

3. When determining the miles assessed for a free-flowing monitoring station, the following items need to be considered:

    a) WQ Standards Use Designations (i.e. Classes and/or Special Standards)

    b) point and/or nonpoint source input to the stream or its tributaries,

    c) changes in watershed characteristics such as land use,

    d) changes in riparian vegetation, stream banks, substrate, slope, or channel morphology,

    e) entry of a large tributary or diversion, or

    f) hydrologic change such as channelization or a dam.

4. For non-Bay program tidal and estuarine stations, EPA guidance suggests using a 4-mile radius for open water stations; a 2-mile radius for sheltered bay stations and a 0.5 mile radius for highly sheltered bay stations. The new Chesapeake Bay WQ Standards criteria adopted the Chesapeake Bay Program segmentation scheme.

5. Segment delineation will be performed using the USGS National Hydrography Dataset (NHD) coverage or other appropriate GIS dataset.

6. Spatial coverage for estuarine probabilistic monitoring stations should be identified in conjunction with the development of the monitoring plan and coordinated by regional monitoring and assessment staff and/or the Chesapeake Bay Program monitoring coordinator and Bay monitoring staff. Estuarine B-IBI data will be assessed according to the methodology recently developed. See Section 6.4.2.3 for additional information.

7. When assessing an impaired segment, it is understood via WQ Standards that the existence of a VPDES permitted mixing zone lies within the impaired segment for a specific pollutant. If a mixing zone exists, the parameter specific mixing zone length is specifically understood as not part of the impaired segment even though map delineation and/or assessment unit description may show the impairment as continuous.

8. Single physical or chemical sample free-flowing probabilistic stations will not be delineated into 303(d) segments. Probabilistic physical/chemical stations meeting Part III Rules #1 and #4 will be delineated and assessed.

Section 6.3 NON DEQ EVALUATION METHODOLOGY

6.3.1 Citizen and Non-agency Monitoring

For the purposes of this guidance document, a citizen water quality monitoring program, or "citizen monitoring", is defined as water quality monitoring which uses volunteers to collect the data. Some of these programs are run by local governments, Soil and Water Conservation Districts, citizen organizations, community organizations or colleges. Generally, K-12 school monitoring is conducted for educational purposes and does not fall under citizen monitoring unless working in cooperation with existing citizen monitoring efforts. Citizen monitoring is not defined as monitoring conducted by all entities external to DEQ, such as colleges and local governments, unless volunteers are used in their efforts.

DEQ does routinely receive water quality data from non-citizen volunteer sources such as local governments, universities, and other non-state or federal sources not defined in Section 6.3.2 in this guidance. The review and assessment of non-agency data is done using the same QA/QC review as with citizen monitoring data.

In 1997, Water Quality Monitoring, Information and Restoration Act (WQMIRA) was passed by the Virginia General Assembly. This bill charged DEQ with monitoring and assessing all the waters within the Commonwealth. During this same General Assembly session, the position of Citizen Monitoring Coordinator (CMC) was added into the operating budget of DEQ. The primary duties of the CMC were providing guidance and support to citizen water quality monitoring groups in the development of monitoring programs and quality assurance project plans. In addition, the CMC facilitated communication among citizen groups and other State agencies, sponsoring citizen monitoring seminars, promoting the use of citizen water quality data in a manner consistent with the data use goals of the organization and encouraging additional citizen monitoring efforts. In 2002, the Virginia General Assembly passed legislation that established the Virginia Citizen Water Quality Monitoring Program in the Code of Virginia (§62.1-44.19:11).

In 2004, the CMC position evolved into the role of Water Quality Data Liaison (WQDL). This was done to centralize the task of requesting any and all available data collected outside of DEQ for inclusion into water quality assessment reports and follow up monitoring by DEQ. The duties and responsibilities of the former CMC position regarding citizen monitoring data submissions and working with the citizen monitoring community have been maintained and expanded to include all other non-DEQ potential sources of water quality data.

Assessment Process:
The process of assessing water quality data submitted to DEQ involves staff from both the central office headquarters and the regional offices. In order to include any citizen or non-agency monitoring data in the bi-annual 305(b)/303(d) Integrated Water Quality Assessment Report (Integrated Report), it must be received and evaluated by the agency. By adhering to the tasks outlined below, the agency can ensure that all qualifying monitoring data is properly assessed.

Submitting Data for Evaluation:

1. All water quality data provided to DEQ from citizen and non-agency organizations should be sent to the WQDL at DEQ. The WQDL and the appropriate QA/QC staff in the Water Monitoring and Assessment (WMA) Office will review all standard operating procedures (SOPs), QA/QC plans or Quality Assurance Project Plans (QAPPs), and Standard Operating Procedures (SOP) for each citizen/non-agency monitoring group submitting chemical data.

For citizen/non-agency chemical and bacteria monitoring programs, the WQDL will work with the WMA Quality Assurance Coordinator (QA Coordinator). The WQDL, QA Coordinator, and the Biological Monitoring Program Coordinator will review all supporting documentation for benthic macroinvertebrate citizen/non-agency monitoring programs. Based upon the review of all procedures, the appropriate use of the data will be determined based on a three-tiered system.

2. The designation of DEQ tiered uses of data will be determined based upon the review of all procedures and in conjunction with the organization submitting the water quality data. Any changes in QA/QC and/or SOP methods and/or any additions or deletions of current monitoring sites should be brought to the attention of the WQDL.

   Since 2007, DEQ has provided a data use authorization form to monitoring groups. Because not all non-DEQ organizations may wish to have their data used for water quality assessment reports, this form allows DEQ to meet their wishes. This authorization form cannot be used to upgrade the use of lower tiered data for a higher tiered purpose. Such an example would be a data submitter requesting DEQ to assess their data for Level III (use for 303(d) listing/delisting of impaired waters) based on Level II or Level I quality data.

Central Office Assessment Tasks:

1. The QA Coordinator, with the help of the WQDL, will provide a copy of all Level II and III citizen and non-agency monitoring data received during a given assessment cycle to the regions. The format of the data provided to the regions will be as follows:

   a. Data will be in electronic spreadsheet format compatible with programs used by the regional assessors.

   b. Level II and III data will be on separate spreadsheets denoting their QA status and assessment use.

   c. All data not meeting QA/QC requirements or otherwise not relevant for assessment will be omitted by the QA Coordinator. However, an unedited master copy of all data submitted will be maintained.

   d. At a minimum, all citizen and non-agency monitoring sites submitted to the regions for assessment will contain the following metadata:
      i. Name of waterbody monitored
      ii. Latitude and Longitude information
      iii. Physical description of the site (i.e. At Route 646 bridge crossing)

2. The WQDL and QA Coordinator will review data collected without SOPs and QAPPs plans. This data will be acknowledged in the applicable river basin evaluation as appropriate.

3. Citizen and non-agency monitoring groups that provided data for the assessment will have a summary of their results placed in a separate Citizen Monitoring/Non-Agency section of the Integrated Report.

4. The QA Coordinator, with the help of the WQDL, will coordinate with each regional office regarding the final assessment of the citizen and non-agency monitored data. In coordination with the WQDL and the 305(b) Coordinator, each regional office should provide any appropriate final editing of the citizen and non-agency monitoring assessment.

5. After the release of the final bi-annual Integrated Report, regional DEQ planning and monitoring staff will receive a list of all stations where monitoring results indicate possible water quality impairments.

This list will identify waters based on the probability of impairment ranked from low to high. The regional monitoring staff should review the station list results and consider including monitoring sites as appropriate to their regional monitoring plan for future monitoring.

6. With the help of the WQDL, the QA Coordinator will provide all data approved by DEQ for use in the Integrated Report in basic data tables. The tables will be posted on the DEQ website along with the final Integrated Report. At a minimum, these data tables should include each individual sample period.

Regional Office Assessment Tasks:

1. All approved conventional parameter data should be summarized by major watershed and characterized according to the procedures and considerations in Part V of this manual.

2. For benthic macroinvertebrate monitoring programs used by citizen and non-agency monitoring organizations, data will be assessed based on the criteria outlined in *Guidance Memo No. 06-2010, Guidelines for DEQ Review and Approval of Biological Monitoring QAPPs*.

    a. For organizations that complete the requirements outlined in the guidance memo for Level III, DEQ staff will assess the data for the purposes of 305(b) water quality assessment and 303(d) listing and delisting of impaired waters. If a validation study showed inconclusive correlation with DEQ benthic protocols, the corresponding scores showing inconclusive correlation will not be assessed as Level III. These 'gray zone' scores may be used to characterize waters with or without observed effects (Category 3C or 3D).

    b. For all other methods not validated by DEQ or using DEQ protocols, biological monitoring sites characterized by citizen and non-agency organizations as "excellent," "good" or "acceptable" should be designated as "Area of low probability for adverse conditions" (Category 3D). Biological sites periodically characterized as "fair," "poor," "unacceptable" or "moderate" should be designated as "Area of medium probability for adverse conditions" and listed as insufficient data with observed effects and prioritized for follow-up monitoring (Category 3C). Likewise, biological sites that are consistently "poor" or "unacceptable" should be characterized as "Area of high probability for adverse conditions" and listed as insufficient data with observed effects with DEQ follow up monitoring to be prioritized (Category 3C).

3. Segment lengths represented by a monitoring site should be determined using the mileage delineation guidance found in Section 6.2.1. Each monitoring site used in the assessment should have a unique station ID using a system similar to the DEQ station ID system. The regional office staff assigns this station ID to each citizen/non-agency monitoring site and relays the station ID to the QA Coordinator.

4. Level III data collected at sites that complement and are comparable (i.e. chemical to chemical comparisons and biological to biological comparisons) to DEQ monitoring sites, should be included in the major basin report. However, the final assessment of that segment will be made using the DEQ monitoring data (found in the appropriate section of the Integrated Report). In this case, the data collected by the monitoring organization would be used as supplemental data.

5. Level III data collected at sites that do not complement or compare (i.e. benthic to chemical comparisons) to DEQ monitored sites, should be included in the major basin report. The final assessment of the segment should be primarily assessed using the non-DEQ monitoring data. For example, Level III citizen benthic macroinvertebrate data shows impairment while a nearby DEQ chemical monitoring station does not directly show benthic impairment.

6. Level II ambient and bacteria data collected at sites will undergo the similar evaluation process as used for Level III and DEQ results. Since Level II data may have some variation in quality assurance,

corresponding waterbodies that indicate poor water quality will be listed as insufficient data with observed effects and prioritized for follow-up monitoring (Category 3C). Waterbodies that have Level II data indicating good water quality will be listed as insufficient data with low probability for adverse conditions (Category 3D).

7. If, during the regional review, a discrepancy between data from DEQ monitoring stations and data from similarly sited citizen or non-agency monitoring station and/or a citizen/non-agency monitoring technique is believed to be suspect, the QA Coordinator should be notified and an attempt to rectify the discrepancy initiated.

   The QA Coordinator and WQDL will evaluate the potential causes for the data disparity and/or review the QAPP and the monitoring techniques of the data submitting group. After this evaluation is complete and a problem is confirmed, the QA Coordinator and WQDL will recommend appropriate corrective actions to the monitoring group for inclusion in the citizen/non-agency monitoring organization's QAPP and/or SOPs.

   Until the discrepancies with the data and/or methods are fully evaluated by the WQDL and the QA Coordinator, the data (either for the specific parameter or for the group) should not be used in agency assessments. If the citizen or non-agency monitoring group does not initiate corrective action, the QAPP for that parameter and/or for the group as a whole may no longer be considered valid by DEQ and the data will not be considered for statewide water quality assessments.

6.3.2 Other State and Federal Water Quality Data

After review and approval of monitoring and QA/QC protocols, DEQ will consider data generated by other State and Federal monitoring programs for use in the Integrated Report. DEQ has established a water quality data sharing agreement with several state and federal agencies that includes the Virginia Department of Health, Tennessee Valley Authority, National Park Service, United States Forest Service, and the United States Geological Survey.

Virginia Department of Health (VDH) - DEQ receives and lists areas closed by VDH for shellfish harvesting due to high bacteria levels. All Enterococcus bacteria results provided by VDH are also used along with any DEQ water quality data in assessing water quality. Any other water quality data collected by VDH and shared with DEQ will be used by DEQ based on review by the WQDL and QA Coordinator.

Tennessee Valley Authority (TVA) - The TVA routinely monitors for E. coli bacteria along TVA reservoirs in Virginia. This data is considered acceptable for assessing water quality in Virginia.

National Park Service - The National Park Service has several long-term monitoring programs in place at many of the national parks in Virginia. Many of the parks monitor for chemical and benthic macroinvertebrate parameters using varying methodologies or procedures. Because of this, the WQDL and QA Coordinator provide guidance to the regional office assessment staff in assessing the data received from the parks.

United States Forest Service (USFS) - The USFS program collected macroinvertebrate data from numerous monitoring stations within the George Washington and Jefferson National Forests. Sampling for macroinvertebrates is conducted utilizing the same collection methodology (Plafkin et al 1989) that DEQ biologists use in the ambient biomonitoring program. Therefore, the raw data collected by the USFS should be highly comparable with DEQ data. The USFS has used the Macroinvertebrate Aggregated Index for Streams (MAIS) to assess this raw data and make an initial water quality interpretation.

The DEQ regional biologists and planners may use the data, provided to DEQ by the USFS, in the Integrated Report if they find it acceptable for assessment purposes. If the regional biologists or planners have information that conflicts with the initial USFS assessment, or for any other reason questions the USFS stream assessment,

they may elect to disregard the USFS assessment results until further verification can be obtained. If the initial assessment is not used, documentation relating to this decision will need to be provided. The regional biologists may elect to reevaluate the raw data using the Virginia Stream Condition Index (VSCI) metrics to confirm consistent assessment methodology and conclusions. If differences become apparent, the regional biologists may decide not to use the assessment data in the Integrated Report until an on-site stream visit can be performed and conditions verified. Final assessment results of the USFS data should be consistent with the ambient biological assessment criteria described in Section 6.4.2 of this guidance. Any non-approved data will not be used directly in the assessment.

United States Geological Survey (USGS) - The USGS monitors several water quality stations throughout Virginia. Data collected by the USGS is considered Level III by DEQ and is used in assessing water quality including 303(d) impairment listings and delistings. Water quality parameters not listed in the most current version of the Virginia Water Quality Standards are not assessed for 303(d) impairment listing, but can be used to assess waters with observed effects (Category 3C/3D).

6.3.3 Nonpoint Source (NPS) Assessment

The 2010 nonpoint source pollution assessment will be performed by the Virginia Department of Conservation and Recreation (DCR) at the 6th order hydrologic units of the National Watershed Boundary Dataset. This assessment will consist of calculations of net loadings of the NPS pollutants - nitrogen, phosphorus, and sediment - per hydrologic unit as well as evaluations of NPS-related measures in these units.

The net loadings of NPS pollutants may be those calculated for the 2008 NPS Assessment or may be updated, depending on pre-assessment land use change determinations. Loadings are significantly influenced by land use/land cover changes once the model is calibrated (as it was in 2008). This is especially true of farm animal related uses such as pasture-cattle grazed, manure acres, etc. Farm animal numbers and distribution are determined using various sources, including the US Census of Agriculture, the DCR Animal Feeding Operation (AFO) database, and DEQ's Virginia Pollution Abatement permits for significant AFOs. If the 2007 Census of Agriculture results become available in time to be evaluated, and if that evaluation reveals a noticeable change in land use or animal counts and dispersal, then the land use/land cover will be remodeled at the 6th order hydrologic unit level and the loadings model rerun for the 2010 NPS Assessment.

Gross loadings of NPS pollutants are determined via a modeling process that closely approximates the results of the Chesapeake Bay Program water quality model in regards to loadings in the Bay watersheds, thereby diminishing the uncertainty of having conflicting assessment results for that portion of the state. This model will then be employed to calculate similar values for non-Bay watersheds to develop consistent statewide loadings. Inputs to this modeling process include:

- A DCR modified land use / land cover layer
- A DCR developed confined animal data set
- Census of Agriculture animal numbers by jurisdiction
- Virginia Department of Forestry (VDOF) forest harvesting data
- Virginia Department of Mines, Minerals, and Energy (VDMME) extraction data
- The USDA's Natural Resources Inventory
- Chesapeake Bay Program Watershed Model output
- USDA statewide and jurisdiction level soil surveys
- VALUES based pasture yields
- A DCR developed table of dominant crop types by modeled hydrologic unit
- National Weather Service weather records for a multi state area
- USGS stream flows from gage stations
- Census of Population and Housing indicators of septic system use by block
- Slopes developed from USGS Digital Elevation Models (DEMs)
- A DCR developed indicator of stream density by modeled hydrologic unit
- A DCR developed manure application schedule by manure type by region

Net loadings are formed by subtracting the reductions in nitrogen, phosphorus, and sediment that are realized from both best management practice (BMP) installations and relevant grant projects from calculated gross loads. This includes BMPs funded and installed through DCR, VDOF, and the USDA. Results will produce NPS pollution rankings per pollutant by categorized land use of the modeled hydrologic units.

In contrast to modeled potential nutrient loadings, the NPS related portions of the most current list of water quality limited waters (from the 303(d) report) will be assessed by modeled hydrologic unit. This will produce rankings of hydrologic units from monitoring - the impaired waters by water regime of the modeled hydrologic units.

Aside from the NPS loadings described above, two variables used in the past NPS assessments for prioritizing watershed protection efforts for biological health will also be recalculated and ranked by modeled hydrologic unit in 2010 – an aquatic Index of Biological Integrity (IBI) and a public source water protection need.

A modified aquatic IBI score, calculated by the Center for Environmental Studies at Virginia Commonwealth University (VCU), will be used to indicate modeled hydrologic units in need of aquatic species health protection. The IBI score will be developed from the most recent aquatic species data collected by DCR, the Virginia Department of Game and Inland Fisheries (VDGIF), and VCU.

As an indication of human health protection concerns, a public surface source water protection variable will be calculated by hydrologic unit. This variable will reflect the area in each hydrologic unit that is within a Zone 1 protection level of public source water intakes as defined by the Virginia Department of Health (VDH), weighted by the population served by each intake.

DCR rates modeled hydrologic units as high, medium, or low for potential NPS problems as indicated by the NPS assessment. This categorization is performed so that approximately the highest 20% of the net loadings by unit are assigned the high rank. The next highest 30% of the net loading values are assigned the medium rank. All other units are assigned a low NPS rank. Rather then make a hard and true category split at these percentages, the category breaks are made where the larger net loading differences occur nearest to the stated percentages.

Impaired riverine and lacustrine waters, as well as the biological indicators, are ranked based on the clustering and spread of values. Impaired estuarine waters are not evaluated at all at this time due to the difficulty of associating their impairment sources with the surrounding land activities.

No single NPS ranking will be produced from the rankings of the various pollutant loadings, biological indicators, and NPS-impaired water regimes. Each user's total ranking needs can be met by deciding which of the ranked categories are pertinent to their program's cause and creating customized rankings using only those categories. DCR will, however, be flagging units with significant combinations of measures from this assessment, such as those with high aquatic biological diversity and/or public water supply protection need, and those with this same condition but with high NPS pollutant threats.

Other NPS reduction activities and results will be summarized. This will include agricultural BMP installations, NPS TMDLs, and Chesapeake Bay Program NPS actions in Virginia.

Section 6.4 DESIGNATED USE EVALUATION METHODOLOGY

6.4.1 Wildlife Use Support

Determination of the degree of use support for wildlife is based on the aquatic life toxic criteria found in 9 VAC 25-260-140 B. Two or more exceedences of the same acute criteria within a 3-year period will result in the water being impaired for wildlife use.

6.4.2 Aquatic Life Use Support

Determination of the degree of use support for aquatic life is based on conventional physical parameters (DO, pH, temperature) and aquatic life toxic criteria along with biological monitoring data and best professional judgment, relying primarily on recent data collected during the current reporting period. Up to 6 additional years of data may be used if they reflect current conditions. Additional potential chemical pollutants with no Water Quality Standard criteria are examined as well. These include sediment and nutrients and they are assessed according to Section 6.5 of this guidance.

- Conventional parameters (Dissolved Oxygen (DO), pH, temperature)

Conventional pollutant data will continue to make up the bulk of free-flowing, estuarine and lake water quality assessments. The Percent Method will be used to determine the degree of use support. The assessment determination is based only on available data except where professional judgment indicates that natural causes are responsible for the exceedences or where there is reason to believe the quality of the data are suspect. Waters not meeting WQ Standards due to natural conditions will be assessed as impaired and the source of impairment listed as "natural conditions". For DO, the instantaneous minimum standard for the specific WQ Standards designated Class of water is used to assess exceedences unless continuous monitoring data is available. A daily average, based on 24 hours of continuous data, may be used where deemed appropriate. A daily average exceedence is considered an exceedence. See Section 6.6 for lake/reservoir DO assessment. Additionally, Chesapeake Bay and tidal tributary estuarine waters will be assessed according to Sections 6.4.2.1 and 6.4.2.3.

6.4.2.1 Chesapeake Bay Sub-categories of Aquatic Life Designated Use

In addition to assessment of criteria for statewide aquatic life designated uses as described elsewhere in this document (e.g. see conventional parameters and toxics), the Chesapeake Bay and its tidal tributaries will be assessed for: 1) subcategories of aquatic life use specific to the Chesapeake Bay estuarine system, and 2) the general narrative standard for aquatic life use through assessment of benthic invertebrate community condition. The following sections describe the aquatic life use sub-categories, applicable criteria, assessment process, segmentation issues, as well as Assessment Database (ADB) and Integrated Reporting issues.

- **Migratory Fish Spawning and Nursery Designated Use**: waters in the Chesapeake Bay and its tidal tributaries that protect the survival, growth and propagation of the early life stages of a balanced, indigenous population of anadromous, semi-anadromous, catadromous and tidal-fresh resident fish species inhabiting spawning and nursery grounds. This designated use extends from the end of tidal waters to the downriver end of spawning and nursery habitats that have been determined through a composite of all targeted anadromous and semi-anadromous fish species' spawning and nursery habitats (see boundaries in U.S. Environmental Protection Agency. 2004. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum*. Chesapeake Bay Program Office, Annapolis, Maryland. This designated use extends horizontally from the shoreline of the body of water to the adjacent shoreline and extends down through the water column to the bottom water-sediment interface. This use applies February 1 through May 31 and applies in addition to the open-water use described in this subsection.

- **Shallow-Water Submerged Aquatic Vegetation Designated Use**: waters in the Chesapeake Bay and its tidal tributaries that support the survival, growth and propagation of submerged aquatic vegetation (rooted, underwater bay grasses). This use applies April 1 through October 31 in tidal-fresh, oligohaline and mesohaline Chesapeake Bay Program segments, and March 1 through November 30 in polyhaline Chesapeake Bay Program segments and applies in addition to the open-water use described in this subsection.

- **Open-Water Aquatic Life Designated Use:** waters in the Chesapeake Bay and its tidal tributaries that protect the survival, growth and propagation of a balanced, indigenous population of aquatic life

inhabiting open-water habitats. This designated use applies year-round but the vertical boundaries change seasonally. October 1 - May 31, the open water aquatic life use extends horizontally from the shoreline at mean low water, to the adjacent shoreline, and extending through the water column to the bottom water-sediment interface. June 1 - September 30, if a pycnocline is present and, in combination with bottom bathymetry and water column circulation patterns, presents a barrier to oxygen replenishment of deeper waters, this designated use extends down into the water column only as far as the upper boundary of the pycnocline. June 1- September 30, if a pycnocline is present but other physical circulation patterns (such as influx of oxygen rich oceanic bottom waters) provide for oxygen replenishment of deeper waters, the open-water aquatic life designated use extends down into the bottom water-sediment interface (see boundaries in U.S. Environmental Protection Agency. 2004. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland. This designated use includes the migratory fish spawning and nursery and shallow-water submerged aquatic vegetation uses.

- **Deep-Water Aquatic Life Designated Use**: waters in the Chesapeake Bay and its tidal tributaries that protect the survival, growth and propagation of a balanced, indigenous population of aquatic life inhabiting deep-water habitats. This designated use extends to the tidally influenced waters located between the upper and lower boundaries of the pycnocline where, in combination with bottom bathymetry (depth, contour & shape) and water circulation patterns, a pycnocline is present and presents a barrier to oxygen replenishment of deeper waters. In some areas, the deep-water designated use extends from the upper boundary of the pycnocline down to the bottom water-sediment interface (see boundaries in U.S. Environmental Protection Agency. 2004. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland. This use applies June 1 - September 30.

- **Deep-Channel Seasonal Refuge Designated Use**: waters in the Chesapeake Bay and its tidal tributaries that protect the survival of a balanced, indigenous population of aquatic life inhabiting deep-channel habitats. This designated use extends to the tidally influenced waters at depths greater than the lower boundary of the pycnocline in areas where, in combination with bottom bathymetry and water circulation patterns, the pycnocline presents a barrier to oxygen replenishment of deeper waters (see boundaries in U.S. Environmental Protection Agency. 2004. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland. This use applies June 1 through September 30.

Dissolved Oxygen Criteria

Designated Use	Criteria Concentration/ Duration	Temporal Application
Migratory fish spawning and nursery	7-day mean ≥ 6 mg/l (tidal habitats with 0-0.5 ppt salinity)	February 1 - May 31
	Instantaneous minimum ≥ 5 mg/l	
Open-water [1]	30 day mean ≥ 5.5 mg/l (tidal habitats with 0-0.5 ppt salinity)	year-round
	30 day mean ≥ 5 mg/l (tidal habitats with >0.5 ppt salinity)	
	7 day mean ≥ 4 mg/l	
	Instantaneous minimum ≥ 3.2 mg/l at temperatures <29°C Instantaneous minimum ≥ 4.3 mg/l at temperatures ≥ 29°C	
Deep-water	30 day mean ≥ 3 mg/l	June 1 - September 30
	1 day mean ≥ 2.3 mg/l	
	Instantaneous minimum ≥ 1.7 mg/l	
Deep-channel	Instantaneous minimum ≥ 1 mg/l	June 1 - September 30

1= In applying this open-water instantaneous criterion to the Chesapeake Bay and its tidal tributaries where the existing water quality for dissolved oxygen exceeds an instantaneous minimum of 3.2 mg/l, that higher water quality for dissolved oxygen shall be provided antidegradation protection in accordance with 9 VAC 25-260-30 subsection A.2.

The following site-specific dissolved oxygen criteria apply to the tidal Mattaponi and Pamunkey Rivers and their tidal tributaries because of seasonal lower dissolved oxygen concentration due to the natural oxygen depleting processes present in the extensive surrounding tidal wetlands. These criteria apply June 1 - September 30 to Chesapeake Bay segments MPNTF, MPNOH, PMKTF, PMKOH and are implemented in accordance with subsection D of 9 VAC 25-260-185.

Designated use	Criteria Concentration/ Duration	Temporal Application
Open-Water	30 day mean ≥ 4.0 mg/l	June 1 - September 30
	Instantaneous minimum ≥ 3.2 mg/l at temperatures < 29°C Instantaneous minimum ≥ 4.3 mg/l at temperatures ≥ 29°C	

Submerged Aquatic Vegetation and Water Clarity Criteria

Designated Use	Chesapeake Bay Program Segment	SAV Acres[1]	Percent light-through-water[2]	Water Clarity Acres[1]	Temporal Application
Shallow-Water Submerged Aquatic Vegetation Use	CB5MH	7,633	22%	14,514	April 1 - October 31
	CB6PH	1,267	22%	3,168	March 1 - November 30
	CB7PH	15,107	22%	34,085	March 1 - November 30
	CB8PH	11	22%	28	March 1 - November 30
	POTTF	2,093	13%	5,233	April 1 - October 31

	POTOH	1,503	13%	3,758	April 1 - October 31
	POTMH	4,250	22%	10,625	April 1 - October 31
	RPPTF	66	13%	165	April 1 - October 31
	RPPOH	4	13%	10	April 1 - October 31
	RPPMH	1700	22%	5000	April 1 - October 31
	CRRMH	768	22%	1,920	April 1 - October 31
	PIAMH	3,479	22%	8,014	April 1 - October 31
	MPNTF	85	13%	213	April 1 - October 31
	MPNOH	-	-	-	-
	PMKTF	187	13%	468	April 1 - October 31
	PMKOH	-	-	-	-
	YRKMH	239	22%	598	April 1 - October 31
	YRKPH	2,793	22%	6,982	March 1 - November 30
	MOBPH	15,901	22%	33,990	March 1 - November 30
	JMSTF2	200	13%	500	April 1 - October 31
	JMSTF1	1000	13%	2500	April 1 - October 31
	APPTF	379	13%	948	April 1 - October 31
	JMSOH	15	13%	38	April 1 - October 31
	CHKOH	535	13%	1,338	April 1 - October 31
	JMSMH	200	22%	500	April 1 - October 31
	JMSPH	300	22%	750	March 1 - November 30
	LYNPH	107	22%	268	March 1 - November 30
	POCOH	-	-	-	-
	POCMH	4,066	22%	9,368	April 1 - October 31
	TANMH	13,579	22%	22,064	April 1 - October 31

1 = The assessment period for SAV and water clarity acres shall be the single best year in the most recent three consecutive years. A minimum of three years within the data assessment window are required when three consecutive years of data are not available,.

2 = Percent Light through Water = $100e^{(-KdZ)}$ where K_d is water column light attenuation coefficient and can be measured directly or converted from a measured secchi depth where K_d = 1.45/secchi depth. Z = depth at location of measurement of K_d.

Chlorophyll *a* Criteria

Designated Use	Chlorophyll *a* Narrative Criterion	Temporal Application
Open Water	Concentrations of chlorophyll *a* in free-floating microscopic aquatic plants (algae) shall not exceed levels that result in undesirable or nuisance aquatic plant life, or render tidal waters unsuitable for the propagation and growth of a balanced, indigenous population of aquatic life or otherwise result in ecologically undesirable water quality conditions such as reduced water clarity, low dissolved oxygen, food supply imbalances, proliferation of species deemed potentially harmful to aquatic life or humans or aesthetically objectionable conditions.	**March 1 - September 30**

The following site specific numerical chlorophyll *a* criteria apply March 1 - May 31 and July 1 - September 30 [as seasonal means] to the tidal James River (excludes tributaries) segments JMSTF2, JMSTF1, JMSOH, JMSMH, JMSPH and are implemented in accordance with subsection D of 9 VAC 25-260-185.

Designated Use	Chlorophyll *a* (µg/l)	Chesapeake Bay Program Segment	Temporal Application
Open-Water	10	JMSTF2	March 1 - May 31
	15	JMSTF1	
	15	JMSOH	
	12	JMSMH	
	12	JMSPH	
	15	JMSTF2	July 1 - September 30
	23	JMSTF1	
	22	JMSOH	
	10	JMSMH	
	10	JMSPH	

Assessment process

Full details of the assessment processes are described in "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries, EPA 903-R-03-002 (USEPA, April 2003)", "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for Chesapeake Bay and Its Tidal Tributaries - 2004 Addendum, EPA 903-R-04-005 (USEPA, October 2004)", and "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries 2007 Addendum, EPA 903-R-07-003 (USEPA, July 2007)". A very general summarization of key aspects of the process follows.

The assessment period for D.O., water clarity and chlorophyll criteria shall be the most recent three consecutive years within the data window. When three consecutive years of data are not available, three years within the most recent data assessment window must be available and used for the assessment.

Attainment of the dissolved oxygen and numeric chlorophyll criteria shall be assessed through comparison of a cumulative frequency distribution of criteria exceedences to the applicable criteria reference curve for each designated use. A first step in the process involves spatial interpolation and extrapolation of data collected at individual fixed locations to project water quality conditions throughout the segment. A subsequent step involves development of cumulative frequency distribution (CFD) of criteria exceedences combining both spatial and temporal domains for each segment-designated use combination. A final step is to compare this CFD of criteria exceedences against a reference CFD of allowable exceedences to determine if the criteria are attained.

For the Shallow Water Submerged Aquatic vegetation use criteria, if the submerged aquatic vegetation (SAV) acres are met in any individual Chesapeake Bay Program segment, then the shallow-water submerged aquatic vegetation use is met in that segment. If the SAV acres are not met, then the water clarity criteria shall be examined with either a CFD methodology or a "water clarity acres" methodology. If sufficient water clarity is available to support SAV growth through either of these alternatives, then the shallow-water submerged aquatic vegetation use is met regardless of the number of acres of SAV in that segment.

The assessment of criteria for Chesapeake Bay continues to undergo refinements. We anticipate that if data of sufficient quantity and quality are available we may be able to use the "spectral analysis" procedure described in the "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and its Tidal Tributaries. EPA 903-R-03-002, (USEPA, April 2003)" next cycle.

Assessment Units

The Chesapeake Bay program segmentation scheme (*Chesapeake Bay Program Analytical Segmentation Scheme-Revisions, Decisions and Rationales: 1983 -2003,* CBP/TRS 268/04. Chesapeake Bay Program, Annapolis, Maryland) shall be used as the assessment unit to determine attainment of the criteria in this section for each designated use. The spatial boundaries of each aquatic life use subcategory within each of these CBP segment are described in the *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland. Assessment results for each CBP segment/designated use will determine the Integrated Report listing category of all waterbodies (i.e. all ADB assessment Units) geographically within that CBP segment/designated use. For example, the listing category of all tidal Onancock Creek assessment units will be determined by the appropriate designated use attainment of CBP segment CB7PH. In this example, it is likely that only open water and shallow water uses of CB7PH extend into Onancock Creek.

Assessment Database (ADB) Reporting Units

The Assessment Database (ADB) is used to track assessment data for all designated uses in distinct geographically defined waterbodies across the state. ADB assessment unit spatial boundaries are defined by many factors including the spatial distribution of available data to assess for designated uses. There may be several ADB assessment units included in each Chesapeake Bay Program segment.

ADB can only accept estuarine assessment units defined by surface areas (i.e. square miles). The complete water column within that assessment unit is assigned to a single overall aquatic life use attainment. Each individual Bay segment assessment unit may have deep channel, deep water, and open water sub-categories of aquatic life designated use (that may only account for a portion of the total volume/area of the ADB assessment unit) which each have its possibly differing attainment status.

Each ADB assessment reporting unit will be designated as having the aquatic life use and sub-use status according to the appropriate CBP segment/Aquatic life sub-designated use assessment. The rules to be applied are:

a) Open water designated extends from "shoreline to shoreline" within each CBP segment and thus all ADB reporting units located within each CBP segment is reported as having "open water" aquatic life use attainment consistent with the CBP segment attainment of open water criteria.
b) Deep water and deep channel designated use spatial boundaries within each CBP segment are spatially constrained as smaller areas within the larger CBP segments (see *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability 2004 Addendum.* Chesapeake Bay Program Office, Annapolis, Maryland. Thus the deep water or deep channel designated use status for each CBP segment will apply only to ADB reporting units which contain a "deep water" designated use area. The actual 2 dimensional (i.e. square miles) size of each deep channel and deep water area will be measured and reported as the actual impaired area (i.e. the whole ADB unit area is not considered impaired if only a smaller deep water or deep channel area was impaired).
c) The Shallow Water Submerged Aquatic vegetation designated use applies only out to a maximum of 2 meter contour. Each ADB unit having this sub-use present in some portion will designate the sub-use as attained or not. However, the actual size of the impaired use will be tracked outside of the ADB system and reported in the Integrated Report as being only the size of area within the 2 meter contour.
d) The general standard aquatic life use status of the ADB unit will be assigned to the "worst case" status of aquatic life sub-use within that ADB assessment unit (e.g. an ADB reporting unit containing an open water use which meets its associated criteria and a deep water use which fails its associated criteria will be categorized as failing the general aquatic life use). Other criteria applicable to the general standard for aquatic life use (e.g. for benthic communities, toxics, or "weight of evidence" etc…) will also determine the overall aquatic life use attainment. If the general aquatic life use is impaired only due to a smaller area of aquatic life sub-use, then only the area (i.e. square mileage) of the sub-use is reported as impaired for general aquatic life use.

303(d) listing (i.e. Category 5)

All 303(d) listings will be based on the above described methods and associated Chesapeake Bay WQ Standards. Chesapeake Bay and tidal tributary criteria assessment units, as described in 9 VAC 25-260-185 (d), that have been previously listed as not supporting the Aquatic Life Use and associated subcategories of Aquatic Life Use due to DO criteria failure will continue to remain impaired until all applicable criteria are attained (e.g. any 7-day mean or instantaneous criteria must be assessed and attained as well as the 30-day criteria). In general, the following decision rules will be used for assigning ADB use category based on dissolved oxygen criteria assessment results.

Dissolved Oxygen Criteria Assessment
ADB Considerations in Bay AU's

(Note: this top-down "flow chart" is for D.O. Standards considerations only. ALUS and AU categorizations could be effected by other applicable WQ Standards considerations as well.)

<table>
<tr><td>AU is 1) Not a CD water, Not been EPA overlisted, Not ever failed any DO criteria in past.</td><td colspan="2">AU is 1) A consent decree water, OR 2) EPA overlisted ("Nutrients" or "Dissolved Oxygen"), OR 3) previously impaired for DO cause by failure of any DO criteria ("old" or "new")</td></tr>
<tr><td>Current Assessment (OW, DW, or DC) meets all assessed DO criteria, some are still not assessed.</td><td colspan="2">Current Assessment (OW, DW, or DC) meets all assessed D.O. criteria but one or more criteria are still not assessed.</td></tr>
<tr><td></td><td>Water is <u>not</u> on "consent decree"</td><td>Water is on "consent decree"</td></tr>
<tr><td>• Applicable Bay use (OW, DW, or DC) is "Fully Supporting".
• ALUS is fully supporting, Category 1 or 2A.
• Overall AU user defined category is dependent on all use attainment considerations.</td><td>• Applicable Bay sub-use (OW, DW, or DC) was impaired and now is "Fully Supporting". Can delist previously listed D.O. cause, i.e. category 2A only for attaining sub-uses.
• ALUS is category 3B "Insufficient Information". Until every D.O. criterion assesses as attaining, the ALUS cannot be classified as any other category relative to D.O.
• Overall AU user defined category is dependent on all use attainment considerations.</td><td>• Applicable Bay sub-use (OW, DW, or DC) is Category 3B "Insufficient Information" for previously listed DO cause.
• ALUS is category 5A "Impaired". Until every D.O. criterion assesses as attaining, the AU cannot be classified as any other category.
• Overall AU user defined category remains 5A "Impaired" for D.O. cause until every D.O. criterion assesses as attaining.</td></tr>
</table>

6.4.2.2 Free-Flowing Biological Assessment

Biological monitoring of streams and rivers using benthic macroinvertebrates is an integral component of the water quality monitoring program in the Commonwealth of Virginia. Biological monitoring allows the Virginia DEQ to assess the ecological condition of streams and rivers. Benthic macroinvertebrate surveys are used to determine if the waterbodies meet their designated aquatic life uses.

The Virginia Stream Condition Index (VSCI)

In 2000, the United States Environmental Protection Agency (USEPA) contracted TetraTech to develop a multimetric macroinvertebrate index for Virginia. This index contains eight core metrics that when calculated into one number is known as the Virginia Stream Condition Index (VSCI). TetraTech developed the VSCI using Virginia's existing biomonitoring database, which contained a significant amount of upstream (reference) control sites for use with the USEPA's Rapid Bioassessment Protocols.

Using an independent, new probabilistic database (sample n=350) with data collected from 2001-2004, Virginia has validated the VSCI using a spatially diverse (ecoregionally and stream size) data set free of pseudoreplication. These probabilistic data sets have allowed DEQ to narrow data gaps and test the proposed VSCI against many classification variables, which include season, stream size, ecoregion, bioregion, river basin, regional office, and sampling technique. The VSCI validation study was designed to incorporate suggestions provided through public comment from the Academic Advisory Committee (AAC), the USEPA and the regulated community.

The validation study using probabilistic biological data has confirmed that the VSCI works well to discriminate between sites with acceptable water quality and habitat versus sites with degraded water quality and habitat. A VSCI impairment threshold score of 60 was determined from statistical analyses of the original TetraTech report and the DEQ validation study. The VSCI validation study and the aquatic life use assessment guidance

using the VSCI has been reviewed and approved by the USEPA. The validation study "Using Probabilistic Monitoring Data to Validate the Non-Coastal Virginia Stream Condition Index" can be found at http://www.deq.virginia.gov/probmon/pdf/scival.pdf .

Aquatic Life Use Determination

The DEQ uses the VSCI for non-coastal streams for biological assessment as well as the Coastal Plain Macroinvertebrate Index (CPMI) for coastal plain streams. Assessment rankings, based on a single VSCI or CPMI bioassessments, are the result of the data evaluation and reduction of numerous measurements and observations conducted during the biomonitoring survey. Bioassessment measures the response of the biological community to all perturbations it has experienced. A single, properly conducted, VSCI or CPMI bioassessment is not a "single data-point" analogous to a single Dissolved Oxygen (DO) measurement or fecal coliform sample. Non-coastal streams with VSCI scores ≥ 60 or coastal plain streams with CPMI scores ≥16 will be assessed as "fully supporting for aquatic life use". VSCI scores < 60 and CPMI scores < 16 will result in streams being listed as "impaired".

If the biologist has observed natural conditions, such as recent drought or flooding, etc, that could be responsible for a ranking below the impairment threshold, they should note the lack of confidence in the survey and the stream will be listed as "fully supporting but having observed effects for aquatic life use" until further analysis can be conducted.

The regional biologists should review the biological assessments for the assessment cycle and they should make a final biological assessment ranking based on these data. Since biomonitoring surveys are records of the condition of the community at the time of the survey, the most recent bioassessment should be the most accurate indicator of stream ecological health. An attempt to average the data would weaken the ability to accurately predict current conditions. In cases where biological assessment rankings fall above and below the impairment threshold over multiple sampling events, more weight should be given to the most recent bioassessment. In cases where only one biomonitoring survey was conducted, a stream may be assessed for aquatic life use based on a single VSCI or CPMI score. A standardized fact sheet, as found in Appendix B of this manual, has been developed to help the regional biologists review and assess the data for the assessment cycle. The fact sheet allows for consideration of supplemental information about the watershed that is important in making the final assessment decision.

6.4.2.3 Estuarine Biological Assessment

In cooperation with EPA Region III (R III) and the State of Maryland, DEQ has developed an assessment methodology for estuarine benthic community biological (B-IBI) data. This methodology assures Bay wide consistency in determinations of estuarine benthic impairments and requires a sample size > 10 for statistical purposes. In order to assist with meeting the sample size requirement, a six-year data window is used. This corresponds with the data window used for the assessment of other non-Chesapeake Bay criteria data.

The methodology incorporates uncertainty in the reference condition and is based on the confidence limit and bootstrap simulation concept described in Alden et al. (2002). Bootstrap simulation (Efron and Tibshirani 1998) will be applied to incorporate uncertainty in reference conditions as well as sampling variability in the assessment data. For each habitat, a threshold based on percentiles in an unimpaired reference data set will be applied (i.e. 5th percentile). This threshold is not intended to serve as criteria for classifying individual B-IBI scores, rather it will be used to categorize the segment as impaired or not based on the proportion of samples below the threshold and the variance associated with this estimate.

The impairment assessment for each segment is based on the proportion of samples below the threshold with the variance in this proportion estimated by simulation. In each simulation run, a subset of the reference "unimpaired" data for each habitat is selected at random, and the threshold is determined (i.e., the B-IBI score at the 5th percentile of the un-impaired dataset). A random subset of the assessment data is compared to the threshold value to estimate the proportion of sites below the threshold. By repeating this process over and over

again (2000 runs) we estimate the variance in the proportion of sites below the threshold from the bootstrap estimates. For this analysis, it is assumed that each reference 'un-impaired" data set (by habitat) is a representative sample from a "super population" of reference sites.

The assessment result for each benthic segment (i.e. % of area with IBI score below 5th percentile threshold) is then statistically compared ($p<.05$) with the percentage that would be expected even if the segment is unimpaired. This percentage under "un-impaired" conditions is assumed to be 5%.

In addition to an assessment of impairment, a discriminant analysis tool (benthic diagnostic tool) has been developed that can be used to identify sources of stress affecting benthic community condition in the Chesapeake Bay (Dauer et al. 2002). The results can distinguish stress due to contaminants versus stress due to other factors (e.g., low dissolved oxygen, or unknown). This tool will be used to identify which impaired segments have high probability of sediment contamination. Separately from the discriminant tool, the B-IBI metric scoring will also be used to identify (1) insufficient abundance patterns consistent with a low dissolved oxygen effect and (2) excessive abundance patterns consistent with eutrophication effects in the absence of low dissolved oxygen events. The combined use of these causal analyses will be used to assign causes for benthic impairments to either 1) Sediment chemical contaminants 2) Low dissolved oxygen 3) Eutrophication or 4) Unknown.

The spatial assessment unit for determining attainment of the general standard for aquatic life use using benthic community data will be the same as used in the 2008 assessment report. These criteria assessment units are described in "*Chesapeake Bay Program Analytical Segmentation Scheme-Revisions, Decisions and Rationales: 1983 -2003,* CBP/TRS 268/04. Chesapeake Bay Program, Annapolis, Maryland" with the additional caveat that minor tidal tributaries are considered separate benthic assessment segments.

Assignment of aquatic life use status, as determined by benthic assessments to ADB reporting waterbodies, will be the same as described previously for the new Bay criteria assessments found in Section 6.4.2.1. Each ADB reporting unit will be assigned the general aquatic life use status of the benthic assessment segment in which it is geographically located.

References:

Alden, R.W. III. 1992. Uncertainty and sediment quality assessments: Confidence limits for the Triad. Environmental Toxicology and Chemistry 11:645-651.

Alden, R.W. III, D.M. Dauer, J.A. Ranasinghe, L.C. Scott, and R.J. Llansó. 2002. Statistical verification of the Chesapeake Bay Benthic Index of Biotic Integrity. Environmetrics 13:473 498.

Dauer, D.M., M.F. Lane, and R.J. Llansó. 2002. Development of diagnostic approaches to determine sources of anthropogenic stress affecting benthic community condition in the Chesapeake Bay. Report submitted to the USEPA Chesapeake Bay Program Office, Annapolis, Maryland, by Old Dominion University Department of Biological Sciences, Norfolk, Virginia. 65 pp.

Efron, B. and R. Tibshirani. 1998. An Introduction to the Bootstrap. Chapman & Hall/CRC.

Llansó, R.J., J.H. Vølstad, and D.M. Dauer. 2003. Decision Process for Identification of Estuarine Benthic Impairments. Final Report submitted to Maryland Department of Natural Resources, Tidewater Ecosystem Assessments, Annapolis, Maryland, by Versar, Inc., Columbia, Maryland.

6.4.3 Fish Consumption Use

The support of the fish consumption use can be based on several types of information. The first type include consumption advisories (limiting consumption) or restrictions (no consumption) issued by the VDH as per the Memorandum of Agreement (MOA) with DEQ. The second type includes the comparison of fish tissue data to WQ Standards criterion based tissue values (TVs) and tissue screening values (TSVs). Waters exceeding the same toxic WQ Standards derived value (TV) listed in Appendix E-1, for fish tissue two or more times are impaired for fish consumption. For example, both of the following situations would qualify as impaired under these criteria. Two fish samples from different species exceeding the same TV during one sampling event or

two or more samples of the same or different species exceeding the same TV from different sampling events within the assessment period are considered impaired. See Section 6.5.2 for additional information on fish tissue analysis. Waters are assessed as impaired for fish consumption use if an advisory, specifically limiting consumption, or a restriction has been enacted. For additional information, fish consumption use support will be determined according to criteria found in Part V. Finally, support of the fish consumption use is determined by comparison to the human health criteria in public water supplies and other surface waters, as listed in the WQ Standards.

6.4.4 Shellfish Consumption Use

Shellfish consumption use support is based on the determination of restrictions or condemnations on the harvesting and marketability of shellfish resources made by the VDH-Division of Shellfish Sanitation (DSS) as of the most recent condemnation list (January 2009) associated with the reporting period. The DSS is the State agency with the statutory authority to determine shellfish harvesting and marketability status. The DSS uses four classifications for describing the status of shellfish waters. They are approved, conditionally approved, restricted, and prohibited and these are assessed according to the considerations found in Part V. A description of these terms follows:

Approved area:	Growing areas from which shellfish may be taken for direct marketing at all times.
Conditionally Approved:	Growing areas where the water quality may be affected by seasonal or sporadic use of boat docks or harbor facilities are considered conditionally approved. Normally, this would occur during the boating season (April 30 through October 31).
Restricted Area:	Growing areas where a sanitary survey indicates a limited degree of pollution which makes it unsafe to market shellfish for direct marketing. Shellfish from such areas may be marketed after purifying or relaying activities in accordance with certain VDH-DSS requirements.
Prohibited Area:	Growing areas where the sanitary survey indicates dangerous numbers pathogenic microorganisms or other contaminants that might reach that area. The harvesting of shellfish from these areas for direct marketing, relaying, or depuration is prohibited. Additionally, prohibited areas due to administrative closures.

Specific information regarding DSS assessment methodology and the listing/delisting flowchart for shellfish waters can be found in Appendix C of this guidance document. For the 305(b)/303(d) Integrated Report, listing and delisting will be based on data assessed for the reporting period. However, as the TMDL begins development, if new or more recent data shows the shellfish water is no longer impaired, a petition for delisting will be crafted and submitted to EPA for their approval by the Watershed Program (TMDL) staff.

6.4.5 Recreation Use

Based on the requirements of Section 305(b), support of the primary and secondary contact recreation uses are assessed together using the similar procedures used in past reports. However, for the 2010 report, E.coli (freshwater) and enterococci (transition zone and saltwater) data will be assessed. Fecal coliform will not be assessed as this indicator was removed from WQ Standards. However, previous fecal coliform impairments will continue to remain on the 303(d) list until the appropriate bacteria indicator is sampled and assessed independently. Waters should be assessed as impaired for recreation use if E. coli or enterococci bacteria data or bathing area closure indicates less than full support. See Part V for additional recreation use assessment information.

6.4.6 Public Water Supply Use

Toxics in drinking water are assessed according to the WQ Standards criteria (9 VAC 25-260-140 B.) for public water supply and support of this use will be based on methodology described in Part V.

Section 6.5 ADDITIONAL PARAMETER ASSESSMENT

6.5.1 Fish Tissue and Sediment Toxics Assessment

- **Fish Tissue (Consumption) Use**

As described in Section 6.4.3, the WMA – Fish Tissue Monitoring Program known as FTM collects fish tissue samples from designated monitoring stations for contaminant analysis. FTM staff identifies the results of any analysis that exceeds the WQ Standards criterion based tissue value (TV) or tissue screening value (TSV) found in Appendix E-1 and E-2 respectively, for the toxic contaminants and provides the data to water quality assessment (WQA) staff. Older fish tissue data may be included where deemed appropriate.

Fish tissue data collected at stations during routine monitoring throughout Virginia represent Tier 1 monitoring data. These Tier 1 monitoring data are meant to identify sites where concentrations of contaminants in the edible portions of commonly consumed fish indicate a potential health risk to humans. Usually, three fish tissue composite samples are analyzed for chemical contaminants at each Tier 1 station. Each is a composite of edible fillets for one species of fish from a top-level predator, a mid-level predator, and a bottom feeder. If Tier 1 results reveal potential problems, a more intensive Tier 2 study is initiated by the FTM staff to determine the magnitude, geographical extent, and potential sources of contamination in the fish. The need for a more intensive Tier 2 study takes into consideration the severity of the potential concern and is initiated as soon after the discovery of a potential problem as resources allow. Generally, if additional information is requested by the Virginia Department of Health (VDH) for determining the need for fish consumption advisories, a follow-up monitoring effort is initiated the year after the discovery of the potential problem. If limited resources prevent this, the water body will be sampled more intensely as soon as resources allow and at least during the next monitoring in the affected river basin which is conducted on a rotational basis every three to five years.

Analytical results for fish tissue are expressed in wet-weight and are compared to WQ Standards TVs and TSVs for the toxic pollutants using EPA risk assessment techniques for non-carcinogen and carcinogen effects. WQ Standards human health calculations use the 10^{-5} risk level adopted by the State Water Control Board in 1992, an average human body weight of 70 kg and a lifetime average fish consumption rate of 17.5 grams per day (general U.S. population adopted in 2008). These same values are used to calculate the human health water quality criteria found in 9 VAC 25-260-140 B. Also included in the calculation are toxicological data pertinent to human health effects. A reference dose (RfD) is used for non-carcinogen toxic effects and a cancer oral slope factor is used for carcinogen effects. TVs are based on the same toxicological data (and body weight, fish consumption, and RfD or cancer risk level) that form the basis for the water quality criteria listed in 9 VAC 25-260-140 B, under the column labeled "Human Health, All Other Surface Waters". These water quality criteria are water column concentrations that are based on a specific fish tissue concentration, which were calculated to represent a safe or acceptable minimal human health risk level. The water quality criteria are designed to prevent the fish from bioconcentrating the toxic contaminants to levels greater than these fish tissue concentrations. The TV concentrations listed in Appendix E-1 represent the same fish tissue concentrations that are the basis for the water quality criteria listed in 9 VAC-25-260-140 B and may be considered the fish tissue concentration equivalent of those water quality criteria. Appendix E-1 contains TVs for all chemicals for which Virginia has adopted water quality criteria. However, many of the TVs listed in Appendix E-1 do not bioaccumulate and are not often found in fish tissue and have been included for completeness. All TVs are rounded to two significant digits.

Appendix E-2 also lists TSVs for additional toxic chemicals for which Virginia has not adopted water quality criteria that are based on fish tissue concentrations (those criteria listed under " Human Health, All Other Surface Waters" in 9 VAC 25-260-140.B). It includes chemicals recommended for monitoring by EPA or of

special interest to DEQ as well as some chemicals that are based on recent changes to toxicological data and/or exposure assumptions that are different from those used to calculate the water quality criteria found in 9 VAC 25-260-140 B. The TSVs are updated using available data from the EPA IRIS database and/or recommendations from EPA or the VDH before each assessment effort.

If a fish tissue composite sample exceeds a single WQ Standards TV or TSV, the water body should be delineated as fully supporting but having an observed effect for the fish consumption use. If the TV for the same toxic pollutant is exceeded in two or more samples from the same site, the water is considered impaired. For example, both of the following situations would qualify as impaired under this criterion: two different fish samples from different species during one sampling event or two or more different samples of the same or different species from different sampling events. Data from all Tier 1 and Tier 2 monitoring studies are evaluated by DEQ as well as provided to the VDH for their consideration of the need for establishing fish consumption advisories. DEQ and VDH have signed a Memorandum of Agreement (MOA) that describes how the agencies exchange information regarding the results of all Tier 1 and Tier 2 fish tissue monitoring. If VDH issues a fishing ban or advisory, limiting consumption, the segment should be designated impaired for fish consumption use based on the advisory. The results of the Tier 2 study should be clearly communicated in the Integrated Report narrative.

- **Sediment (aquatic life use)**

Similar to the sediment monitoring and analysis conducted by FTM, the regional offices will assess the AWQM sediment data. For freshwater sediments above the fall-line and tidal fresh zones, as described in the WQ Standards, the Consensus Based Probable Effects Concentrations (PEC; MacDonald et al. 2000) should be applied. Estuarine sediment contaminant data collected during scheduled AWQM monitoring should be compared to National Oceanic and Atmospheric Administration (NOAA *Screening Quick Reference Tables* (SQuiRT) Tables 1999) for effects-range-median (ER-M) SVs for sediment. Transition zones should be assessed against the more stringent of the two screening values. One or more exceedences of an ER-M/PEC value results in a fully supporting but having observed effects status for aquatic life use support. In these cases, additional biological monitoring should be scheduled to assess actual aquatic life use support. For National Coastal Assessment, a "weight of evidence" approach using sediment toxicity and sediment chemistry will be used to determine aquatic life designated use. See Section 6.5.3 for additional information. All metals contaminant screening values found in Appendix F have been converted to parts per million (ppm) for consistency.

6.5.2 Additional Toxics Evaluation

- **Freshwater Toxics Evaluation**

For overall freshwater toxics evaluation, DEQ uses the Virginia WQ Standards for human health in surface waters, other than public water supplies (9 VAC 25-260-140 B). These same values are used to assess the fish consumption use in public water supplies as well as all other surface waters. (Please note the criteria for human health in public water supplies will be used to assess the drinking water use in PWSs only). For metals assessment, only dissolved metals data will be used. In conformance with water quality management plans and VPDES permitting procedures, water column toxicant data collected up to 6 years prior to the current 305(b) period should be assessed along with current data if they reflect current conditions. When assessing the aquatic life and wildlife use support for toxic contaminants, compliance should be based on meeting the aquatic life WQ Standards found in 9 VAC 25-260-140 B. See Part V for additional information.

For 2010, Virginia will declare waters impaired for aquatic life use and included in Category 5A if a 30-day semi-permeable membrane device (SPMD) sampled parameter exceeds a water quality criteria two or more times within a 3-year period. As in the past, DEQ will identify other waters of concern as having observed effects and will schedule additional monitoring, if appropriate, to determine if the designated uses are being met.

- **Weight-of-Evidence Aquatic Life Use Assessment in Estuarine Waters**

The "Weight-of-Evidence" (WOE) approach that DEQ currently uses for its general evaluation and assessment of the designated Aquatic Life Use (ALU) for estuarine benthic communities has evolved from a previously more limited application of the "Sediment Quality Triad" concept (SQT – Figure 1). The SQT concept was originally conceived and applied for the evaluation of the presence and effects of toxic contaminants in marine sediments (Long and Chapman, 1985). It was further applied by Chapman et al. (1986, 1987), and has continued to be one of the preferred approaches for the evaluation of toxics in marine and estuarine benthic environments (Chapman, 1992; Chapman et al., 1997; McGee et al., 2001). The Interstate Chesapeake Bay Program (CBP) employed SQT evaluations along with other methods to produce a Bay-wide toxics characterization in 1999 (US EPA, 1999) that identified (1) "Regions of Concern – areas with probable adverse effects," (2) "Areas of Emphasis – areas with potential adverse effects," (3) "Areas with Low Probability for Adverse Effects", and (4) "Areas with Insufficient or Inconclusive Data" relative to toxics contamination in Bay waters. A map showing the results of that characterization is available at: http://www.chesapeakebay.net/pubs/maps/2002-130.pdf. Maps of more recent characterizations (2008, 2009) can be found at: http://www.chesapeakebay.net/maps.aspx?menuitem=15230.

Subsequent to the 1999 characterization, DEQ, in conjunction with researchers from the Virginia Institute of Marine Science (VIMS), used the SQT for the characterization of those Virginia Bay waters that had been identified as Class 4 (Insufficient or Inconclusive Data) in the previous CBP study, namely the tidal fresh regions of the James River, the tidal York River drainage, and Mobjack Bay (Roberts et al., 2002a, 2002b, 2003).

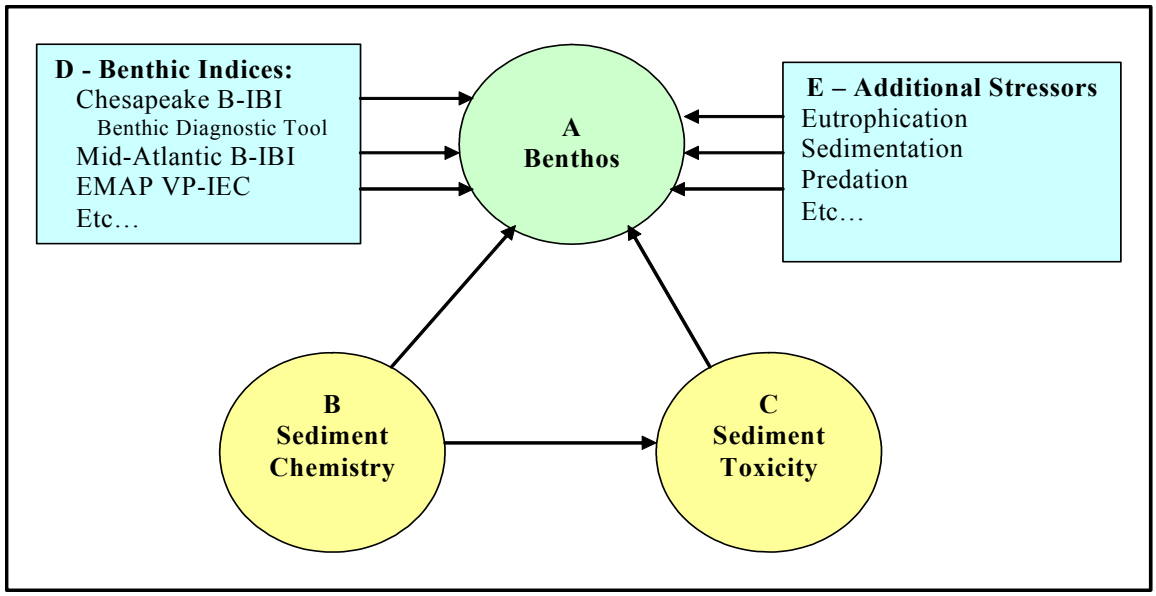


Figure 1 - The Sediment Quality Triad (SQT = triangle A.B.C.) as originally conceived for the identification and characterization of potential toxics-induced stressors. The apex of the triangle, Circle A or "Benthos," represents the condition of the benthic community, which is the primary objective of the "Aquatic Life Use" assessment, while B - "Sediment Chemistry" and C - "Sediment Toxicity" provide two lines of evidence for the evaluation of possible causes of stress due to toxic contamination. Tools for the evaluation of benthic condition (D – "Benthic Indices") and "Additional Stressors" (E), as well as Sediment Chemistry (B), and Sediment Toxicity (C), are discussed in the text.

The original objective of such ambient toxics monitoring was primarily to perform a quick screening of the medium of interest (water, sediment, fish tissue, etc.) to determine whether toxic pollutants were present and could potentially have a negative impact on aquatic life or human health. In addition to the evaluation of potential *causes* of impact (based on Sediment Chemistry – element B), potential toxic *effects* on the biota (including individual survival, growth and/or reproduction) could be evaluated based on the results of toxicity tests (Sediment Toxicity – element C), most commonly conducted in the laboratory but at times carried out with test species maintained *in situ* (*e.g.*, Roberts et al., 2002a, 2002b, 2003). The general welfare of the benthic

community in the field (Benthos – element A) was evaluated as a manifestation of elements B and C (if they were positive), i.e. actual *observed effects* of sediment contamination. Although the potential effects of other stressors were acknowledged, they did not play a significant role in the earlier SQT evaluations.

The Virginia DEQ began to apply a modified, more formal Weight-of-Evidence assessment procedure employing the Sediment Quality Triad in its 2006 Integrated 305(b)/303(d) Water Quality Assessment Report. DEQ's assessment procedure, however, goes beyond the original SQT toxics-related evaluations and includes tools for the tentative evaluation of some of the additional potential stressors (E – "Additional Stressors" of Figure 1) effecting estuarine benthic communities. WOE assessment is carried out on data collected by DEQ's Estuarine Probabilistic Monitoring Program (ProbMon) which samples the coastal Delmarva region, the Back Bay / North Landing River region, and the tidal tributaries and embayments of the Chesapeake Bay drainage. Because all three elements of the SQT are collected and water quality and additional sediment analyses are carried out simultaneously, the WOE procedure is able to provide an integrated assessment for individual sampling sites. General guidance for the delineation of the area represented by each site is provided in Section 6.2.1, "Monitoring Station Delineation", Rule 4, of this Assessment Guidance Manual. It should be pointed out here that, within the tidal portions of the Chesapeake Bay basin, the weight-of-evidence assessment discussed in this section complements the probabilistic benthic assessments carried out by Virginia's Chesapeake Bay Program (CBP). The probabilistic benthic monitoring carried out by the CBP collects benthic samples and a few measures of bottom conditions at each site (sediment type and TOC content, salinity, dissolved oxygen, etc), but does not carry out chemical analyses or toxicity tests of sediment. Consequently, the results of CBP benthic characterizations are spatially integrated and a single assessment is performed only on pre-designated Bay segments that have a sufficiently large sample size ($N \geq 10$).

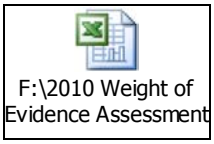
The SQT is an effects-based approach that describes the condition of the sediment and associated benthic infaunal communities relative to toxic pollutants and their effects. The three main data components that were integrated into the original "weight-of-evidence" (WOE) SQT analysis included: (1) sediment bulk chemical concentrations, (2) sediment toxicity test results, and (3) an evaluation of benthic infauna community condition. Rather than considering each type of characterization individually, the complementary methods integrate biological responses with chemical data (Chapman, 1992) for a more scientifically defensible assessment process. Chapman (1992) provided eight possible scenarios from which conclusions could be drawn with the SQT approach. It was this concept that first served as the foundation required to implement the "weight of evidence" assessment of triad data as summarized in the evaluation matrix of Figure 2, below.

The objective of this guidance is to provide orientation for interpreting data generated by the traditional SQT approach, as complemented by additional lines of evidence, with added insight on how to consider "weighting" of each component. This is not to suggest that sound scientific interpretation and best professional judgment are unnecessary, but does provide some degree of standardization for the process. Conceptually, this is similar to the approach used by the Chesapeake Bay Program and its partners for its Toxics Characterization of the Bay (EPA 903-R-00-010, June 1999). The use of this guidance will provide assistance in applying "weights" to the different triad components, which are then inserted into the classic SQT matrix. The bulk chemistry results, for example, can receive additional weighting based on the magnitude of exceedence of the applicable Sediment Quality Guideline (SQG). For toxicity tests, greater weight is applied with two or more statistically significant sediment toxicity tests than is applied to a single significant test, for the effected endpoint. The type of toxicity test endpoints that exhibit statistical significance must also be given consideration, since the acute ecological consequence of not surviving would be greater on the population of a species than the rate of growth of individuals. Test results based on survival/mortality would therefore receive a greater weight.

All of the data contributing to each line of evidence, the intermediate results, the tentative conclusions, and the final integrated WOE assessment are aggregated into a single "Weight of Evidence Assessment (Excel ®) Workbook" for each site. An example of the basic template used for the Weight-of-Evidence Assessment Workbooks is provided here for reference. An example of a completed workbook will be provided later in this section.

	Scenario	Chemistry	Toxicity	Benthic Community Alteration	Total Score (Sum)	Tentative/Possible Conclusions	Listing Category (Weight dependent)
Observed Scores	>>>	-	-	-	**0**	**???**	**???**
Hypothetical Scenarios	1	Score > 0	Score > 0	Score > 0	3-9	If "3" in all three categories, strong evidence for chemical contaminant-induced degradation. (Benthic "Diagnostic Tool" results?)	**VA Category 5A (Cause = Toxics) or 3B**
	2	0	0	0	0	Strong evidence for absence of chemical contaminant-induced degradation.	**VA Category 2A**
	3	Score > 0	0	0	1-3	Chemical contaminants are not bioavailable.	**VA Category 2A (or 2B)**
	4	0	Score > 0	0	1-3	Unmeasured chemical contaminants or conditions may exist that have the potential to cause degradation.	**VA Category 2A, 2B (or 3B)**
	5	0	0	Score > 0	1-3	Alteration is probably not due to chemical contaminants. Bay waters - moderate to severe benthic degradation => 3B (Benthic "Diagnostic Tool" results?); Elsewhere, severe benthic degradation =>5A when corroborated by two or more indices.	**VA Category 3B or 5A (Cause = Water Quality)**
	6	Score > 0	Score > 0	0	2-6	Chemical contaminants are likely stressing the system.	**VA Category 3B (or 2B)**
	7	0	Score > 0	Score > 0	2-6	Unmeasured chemical contaminants are causing degradation. Slight or moderate benthic degradation => 3B (or 2B); severe benthic degradation => 5A. (Benthic "Diagnostic Tool" results?)	**VA Category 3B (or 2B); or 5A**
	8	Score > 0	0	Score > 0	2-6	Chemical contaminants are not bioavailable or benthic alteration is not due to chemical contaminants. (Benthic "Diagnostic Tool" results?)	**VA Category 3B or 5A (Cause = Water Quality)**

Figure 2 - The SQT Evaluation Matrix summarizing the eight scenarios originally described by Chapman (1992). Refer to the "SQT Evaluation Matrix" Tab of the Weight-of-Evidence Assessment Workbook. This matrix has been adapted from the original in order to incorporate additional lines of evidence and to provide numerical scores for the three classes of characterization: Chemistry, Toxicity and Benthic Community Alteration. The penultimate column summarizes Chapman's descriptions of the eight possible scenarios with the addition of some comments on possible assessment classifications, and the last column lists the specific listing categories that may be assigned for Virginia's 305(b)/303(d) Integrated Water Quality Assessment Report. Further discussion of the matrix is provided in the text sections below related to the Ms Excel® "Weight-of-Evidence Assessment Workbook."



Weight-of-Evidence Workbook – Blank Template
To open the Ms Excel® Workbook, double left-click on the icon.

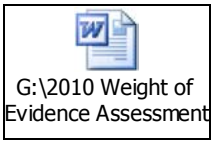
The complete Weight-of-Evidence Workbook consists of 12 individual worksheets that fully document the location of the monitoring site, the complete analytical results of sediment chemical analyses, of sediment toxicity tests and of benthic identifications and enumerations, the interpretation of those results, and the integration of all lines of evidence into a final assessment:

Page No. Title

1. Orientation - Read Me First
2. Summary Sheet
3. SQT Evaluation Matrix
4. (1) Sediment Chemistry
5. (2) Dissolved PAH Evaluations
6. (3) Sediment Toxicity
7. (4) Benthic Infauna

8. SedChem Data
9. Chemistry QA Codes
10. SedTox Data
11. Benthic Data
12. Site Map

In keeping with DEQ's continual planning process, the WOE assessment procedure and the format of the Weight-of-Evidence Assessment workbook continue to evolve as additional lines of evidence and new assessment tools become available. The following discussions will describe the various lines of evidence considered and summarize the characterization procedures as currently employed (April 2009). More details and explicit instructions relative to each step are included in the Weight-of-Evidence Workbook. EPA-defined assessment categories and Virginia's subcategory classifications referred to in the workbook are summarized in the Ms Word® document "Virginia-Defined Assessment Categories and Subcategories" that is linked via the icon below.



Virginia-Defined Assessment Categories and Subcategories
To open the Ms Word ® document, double left-click on the icon.

Workbook Summary Sheet - Final Assessment and Comments:
Descriptive information identifying the specific sampling site is entered into this workbook Tab prior to adding additional results of field measurements and laboratory analyses here or elsewhere in the file. As on other tabs throughout the workbook, information should be typed or pasted into fields that are highlighted in pastel green. Fields that are highlighted in pale yellow should not be altered in any way. Yellow fields are populated automatically by embedded calculations or direct transfers from other fields within the workbook.

Benthic Community Characterization: Workbook Tab 4
Because the WOE assessment is applied strictly for the designated "Aquatic Life Use" (ALU), evaluation of the structure and function of the benthic community is the ultimate, most heavily weighted indicator for site characterizations. The condition of the benthic community constitutes an integrated ***observed effect*** of the existing environmental stressors, whether the individual stressors are identified or not. If the benthic community is found to be severely degraded, a site may be assessed as "Impaired" for ALU even if evidence for a specific cause is lacking. Additional, conformational sampling would be required, however, prior to initiating TMDL development. In the opposing case, if the benthic community was found to be in good condition ("non-degraded" or "meeting goals"), a classification of "(5A) Impaired" would be unlikely unless chemical and/or toxicity results were exceptionally extreme.

The general objective of the weight-of-evidence (WOE) assessment methodology is to integrate multiple lines of evidence, based primarily on sediment analyses, to provide a standardized, objective evaluation of the severity and probable cause(s) of benthic degradation. Individual benthic index scores are subject to sampling error, which results from the great heterogeneity of biological communities as well as from methodological variations in sample collection, handling and analysis. When additional lines of evidence such as significant chemical contamination and/or significant acute or chronic toxic effects corroborate low benthic IBI scores, they serve to identify probable causes of degradation, and consequently to confirm the validity of low benthic scores and to justify an assessment classification of "Impaired" (5A). When low benthic scores are not corroborated by integrative chemical or toxicological measures, additional lines of evidence (e.g., low DO, high nutrient concentrations, evidence of sedimentation, or other habitat characterizations) may contribute to their

interpretation. These alternative lines of evidence are of limited value, however, in the case of single-visit probabilistic sampling.

Within tidal Chesapeake Bay waters the natural variability of benthic communities, both within and among habitat types, is recognized and included in a formal statistically-based procedure which integrates multiple ($N \geq 10$) CBP probabilistic benthic IBI scores for ALU assessment of pre-defined tidal water segments. The benthic IBI scores from the Estuarine Probabilistic Monitoring Program (ProbMon) are included in this procedure. Consequently, within Bay waters and in the absence of corroborating evidence from chemical or toxicological measures, benthic IBI scores from this ProbMon program are integrated into the CBP assessment and are not further evaluated using the WOE approach. In non-Bay tidal waters, however, where no other benthic community evaluation is carried out, the WOE assessment places greater weight on alternative lines of evidence from the probabilistic sample, including the degree of consensus among the three benthic indices generally calculated. In coastal Delmarva waters and in the Albemarle Sound drainage (Back Bay, North Landing River), greatest weight is given to the Middle Atlantic Benthic IBI. In these waters, if the CBP Benthic IBI and/or the EMAP Virginia Province Index of Estuarine Condition corroborate evidence of severe benthic degradation, an assessment of impaired ALU may result even in the absence of supporting chemical or toxicological evidence.

The number of different benthic taxa present in a standardized sample[1], their relative abundances, and knowledge of their specific ecological/functional roles provide the information for calculating numerous measures or metrics of community structure and function. Several of these metrics are used individually for a preliminary, general characterization of the benthic community while many of them are subsequently integrated into various more objective multi-metric indices of biological integrity (Benthic IBIs) or of estuarine condition (IEC). Raw taxonomic data and intermediate results are provided on the "Benthic Data" Tab of the WOE Workbook, while the integrated evaluation is summarized on Tab (4) – Benthic Infauna.

The values of seven individual metrics derived from the taxonomic results provide an initial qualitative evaluation of benthic condition during the WOE process. The first five are measures of taxonomic abundance and diversity, while the last two are the abundances of two stress-tolerant taxa that are also used in calculating an IEC, to be discussed below.

1. Total Abundance - The total number of individuals in a benthic sample; generally symbolized as "N".
2. Total Taxa - The total number of taxa that are identified from a sample. Depending upon the group of organisms, an individual taxon may represent a species, a genus, a family, or a higher level of identification. Usually symbolized as "S" for number of species, but "S" is maintained here as the number of taxa.
3. Shannon H' - The Shannon-Weiner Species Diversity Index: $H' = -\Sigma_{i=1,S} (p_i \ln p_i)$. This index was originally expressed using $\log_2$, but is most often calculated using natural logs (ln) or occasionally using decimal logs ($\log_{10}$). The use of "S" as defined here would make H' an index of taxonomic diversity rather than of species diversity.
4. Gleason-D - Gleason's Diversity Index: $D = S / \ln N$
5. Pielou-J' - Pielou's Index of Equitability (or Evenness): $J' = H' / H'_{max}$ where H'_{max} is the theoretical maximum diversity with "N" individuals divided among "S" taxa. The

[1] The standardized benthic sample for the Estuarine Probabilistic Monitoring Program consists of a composite of two separate sediment grabs using a 6-inch Petite Ponar benthic sampler, representing a total bottom area of approximately 0.046 m^2. The contents of each grab must conform to quality assurance criteria specified in the National Coastal Assessment program QAPP and must include at least 7.0 cm of sediment. The B-IBI results with this sampling protocol have been shown not to differ significantly from standardized samples collected with a single 8" Young sampler (Dauer and Lane, 2005).

value of J' can vary from 0.0 to 1.0; both H' and H'_{max} must be calculated to the same logarithmic base; in this case $H'_{max} = \ln(S)$

6. Tubificidae - The numeric abundance of the family Tubificidae (Annelida, Oligochaete), a stress-tolerant taxon.

7. Siponidae - The numeric abundance of the family Siponidae (Annelida, Polychaete), another stress-tolerant taxon.

Although the abundance of individuals and the diversity of taxa vary among habitat types - muddy vs. sandy sediment, in combination with salinity regime - within a specific habitat type higher values of metrics 1 through 5 are generally indicative of more healthy, less degraded benthic communities. A high abundance (metric 1) with few taxa (metric 2) may indicate a degraded benthic community, especially if the abundant taxa are stress-tolerant as are those of metrics 6 and 7. This would result in relatively low values for metrics 3, 4 and 5. An excessive abundance of tubificids (6) and/or siponids (7) generally indicates a highly stressed and probably degraded benthic community.

Benthic community alteration is also evaluated by integrating various individual metric scores into a single Benthic Index of Biotic Integrity (B-IBI) based on previously established and verified thresholds (e.g., Chesapeake Bay B-IBI; Weisberg et al., 1997), and then comparing the overall site B-IBI score with the defined ranges characteristic of specific habitat types (e.g., Llansó et al., 2003 for the Chesapeake Bay). Weighting the overall benthic community condition with this CBP B-IBI is straight-forward, since there are four previously established categories ranging from good to severely degraded (Please refer to Table 4, below). It is the preferred and most appropriate index for use within the Chesapeake Bay drainage. An alternate B-IBI, developed for estuaries of the Middle Atlantic Region (Llansó et al., 2002a, 2002b), is used for assessment in the Atlantic coastal estuarine waters of the Delmarva Peninsula. Index values < 3.0 for this B-IBI are considered to be indicative of stressed benthic assemblages and degraded conditions (SQT Matrix Score = 3 or 2), while scores ≥ 3.0 indicate that benthic goals are met (Matrix Score = 0).

Table 4 - Chesapeake Bay B-IBI Ranges and Benthic Community Condition

CBP B-IBI Score	Benthic Community Condition	SQT Matrix Score
≥ 3.0	Meets Goal	0
2.7-2.9	Marginal	1
2.1-2.6	Degraded	2
≤ 2.0	Severely Degraded	3

When one or more measurements essential for the calculation of either of these B-IBIs is lacking, or if they are considered geographically inappropriate, a third alternative is available. Paul et al. (2001) developed a benthic-based "Index of Estuarine Condition" (VP-IEC) for the Virginian Biogeographic Province (from Cape Cod to the mouth of Chesapeake Bay), based on the 1990-1993 results of EPA's Middle Atlantic Integrated Assessment (MAIA) Program. This index is given minimum weight when either of the B-IBIs is available and more appropriate, but is more heavily weighted when neither of the B-IBIs is available. In the original publication of the VP-IEC, calculated as a linear discriminant function, final values greater than zero (> 0.000) were interpreted as an indication of non-degraded conditions and values less than zero (< 0.000) were interpreted as an indication of degraded sites. No indeterminate "gray zone" was specified. For the purpose of weight-of-evidence assessment, discriminant scores of this index between -0.1 and +0.1 are considered "marginal." Although no systematic salinity-induced bias has been demonstrated for any of these indices, it should be noted that all three are notably less reliable in low-salinity habitats, *i.e.*, oligohaline and tidal fresh waters (salinity < 5.0 ppt). Approximately 20% of Virginia's estuarine probabilistic sites sampled between 2001 and 2008 were within this salinity range.

Back Bay and the North Landing River, in southeastern coastal Virginia, fall within the Carolinian Biogeographic Province. They constitute a unique tidal freshwater/oligohaline region that is so isolated from Albemarle Sound and the Atlantic Ocean that none of the previously described benthic indices may be completely appropriate. Most of the benthos in this region is more characteristic of freshwater than of tidal estuarine waters. For the purpose of assessment in this region, all three benthic indices are compared and a tentative characterization is based on the relative degree of concordance among them and other individual metrics of species abundance, taxonomic richness, and diversity.

Since the summer of 2005, the separation, taxonomic identification and enumeration of all benthic samples collected within the Estuarine ProbMon Program has been carried out at the Benthic Ecology Laboratory (BEL) at Old Dominion University (ODU) under the auspices of Dr. Dan Dauer. Dr. Dauer is the principal investigator responsible for Virginia's portion of the Chesapeake Bay Program's Probabilistic Benthic Monitoring Program. In addition to providing a complete list of all benthic taxa and their abundances (in terms of numbers of individuals and biomass), the BEL database calculates all of the individual metrics required and the final score for each of the benthic and estuarine indices discussed above. In practice, all three benthic indices are calculated and evaluated for all benthic samples. The greatest weight is given to the results of the most appropriate index, but the degree of concordance (or disagreement) among the three is also considered for the final characterization.

Tab (4) "Benthic Infauna" of the WOE Assessment Workbook summarizes the integrated scoring and weighting for the three benthic and condition indices, along with a number of associated habitat and sediment characteristics that contribute to the final characterization of the benthic community. Several of these complementary characteristics (*e.g.*, bottom DO, bottom temperature, sediment TOC, and habitat type – salinity regime and mud or sand substrate) are helpful in identifying potential causes of any observed benthic degradation. Comments and the final Matrix Score recorded on Tab (4) are subsequently transferred to the SQT Evaluation Matrix Tab for integration into the final assessment.

Under special conditions (*i.e.*, when the CBP B-IBI indicates significant degradation of the benthic community at sites within the Chesapeake Bay drainage) an additional "Benthic Diagnostic Tool", developed for the Chesapeake Bay Program by Dr. Dan Dauer et al. (2002), may be utilized to tentatively identify the potential cause(s). These analyses are carried out by the CBP Program on a biennial basis for the Integrated 305(b)/303(d) Water Quality Assessment Report. The procedure is described in more detail elsewhere in this Assessment Guidance Manual. When the results become available they are added to Tab (4) – "Benthic Infauna" of the WOE Assessment Workbook as one additional line of evidence for determining probable causes of benthic degradation. The presence or absence of the diagnostic tool results does not influence the final assessment classification in any way.

Sediment Characterization: Workbook Tabs (1), (2), and (3)

<u>Sediment Chemistry</u>: Workbook Tab (1)

At the present time, EPA has not yet established specific criteria for toxic contaminants in sediment, and Virginia has not established sediment quality standards against which to assess sediment contamination. Consequently, a site is rarely assessed as impaired based on sediment chemistry alone. However, numerous empirical studies carried out over the past 15 to 20 years have provided "Sediment Quality Guidelines" (SQGs) or "Screening Values" (SVs) that serve to tentatively identify the range of concentrations of specific contaminants or classes of contaminants that are likely to cause adverse effects in benthic communities. Virginia currently employs two sets of screening values to characterize sediments: consensus-based Probable Effects Concentrations (PECs - MacDonald et al., 2000) for freshwater sediments and Effects Range Median (ER-M - Long et al., 1995) concentrations for estuarine and marine sediments. APPENDIX F of this Assessment Guidance Manual lists the "Consensus Based and ERM Sediment Screening Values" currently applied in Virginia. They also appear on Tab (1) - "Sediment Chemistry" of the WOE Assessment Workbook,

where they are compared to observed sediment contaminant concentrations. Virginia's Water Quality Standards ("WQS" - 9 VAC 25-260) provide guidelines for the application of these screening values and indicate that in transitional Class II (oligohaline) waters the "more stringent of either the freshwater or saltwater criteria apply." Section 9 VAC 25-260-140, Subsection C, of the WQS defines specific, fixed zones of transitional Class II waters for Virginia's major tidal tributaries (Potomac, Rappahannock, York, and James Rivers) and Back Bay. (Transitional or oligohaline waters vary in salinity from 0.5 ppt. to 5.0 ppt.) Fixed transition zones within the Chesapeake Bay drainage correspond with pre-established Chesapeake Bay Program assessment segments. However, at any specific estuarine site the salinity, the sediment chemistry, and the resultant toxicity of contaminants vary temporally. As a consequence, the bottom salinity observed at the time of sampling is used to define habitat classes for benthic IBI evaluation and for the selection of PEC *vs.* ER-M screening values for WOE assessment. To assure maximum protection of the aquatic life community during WOE assessment, the concept of applying the "more stringent of either the freshwater or saltwater criteria" is also extended to include tidal fresh waters. An exceedence of these screening values raises a red flag of warning, but does not in itself result in an "Impaired" assessment. The final assessment classification - impaired, observed *potential* effects, or fully supporting of ALU, ultimately depends upon the *observed effects* on the benthic community and not upon *potential causes* identified with the use of screening values.

When the appropriate SVs are exceeded for one or more contaminants, and no ancillary biological data are available to corroborate significant degradation, the site is still considered fully supporting but having *observed (potential) effects* status for aquatic life use support (Virginia Assessment Category 3B). In such cases, additional biological monitoring should be scheduled to assess actual aquatic life use support. In practice, for WOE assessment, each SV is evaluated based upon its Sediment Quality Guideline Quotient (SQGQ, sometimes abbreviated as "Q"), which is calculated as the ratio between the observed concentration in the sediment and the screening value: SQGQ = observed concentration / SV. A ratio of 1.0 or greater indicates that the screening value was exceeded. A ratio of 2.0 indicates that the observed concentration was twice the screening value, etc. In the WOE assessment, the magnitude of each exceedence, abbreviated as "Q", is considered and weighted in scoring the degree of chemical contamination. A summary of the SQT Matrix Scoring Guidelines for sediment contamination can be found at the top of Tab (1) - "Sediment Chemistry" of the WOE Assessment Workbook.

The use of such screening values for assessment suffers several limitations. First, although they are available for most of the trace toxics metals, they are only available for a very limited number of organic contaminants. Secondly, each screening value reflects the potential effects of a single contaminant and does not consider possible interactions with other contaminants in the same sediment matrix. The often significant effects of additivity, antagonism, and synergism are not considered. A number of efforts have been made in recent years to integrate SQG quotients across multiple contaminants (see Long et al., 2006 for a critical review). The most successful and commonly applied integrated measure is the mean SQG quotient (mSQGQ). In a study of southeastern estuaries Hyland et al. (1999), applying the methods of Long et al. (1998), demonstrated that sites with mean SQG quotients as low as 0.1 had relatively high probabilities of significant degradation of their benthic communities. Applying the mean ER-M quotient of eight trace metals (excluding Ni), 13 PAHs (excluding total PAHs), total PCBs, plus 4,4'-DDE and total DDT, they found that when the mean ER-M quotient exceeded 0.1, the probability of adverse effects on the benthic community was ≥ 0.75. Similar results were observed when using mean quotients for another set of sediment quality guidelines, the Probable Effects Concentration (PEC). For the purpose of WOE assessment, therefore, when the mean SQG quotient for the selected contaminants exceeds 0.1 a positive chemical score is reported, whether an individual screening value is exceeded or not.

<u>Equilibrium Partitioning Sediment Benchmarks (ESBs) - PAHs:</u> Workbook Tab (2) - Dissolved PAH Evaluations

The concentration of dissolved contaminants in the interstitial water of sediment may also stress benthic infauna. The interstitial water in sediment is difficult to collect and analyze accurately and this is not commonly carried out during normal monitoring programs. However, the concentrations of dissolved contaminants in

interstitial water can be estimated from the concentrations in the sediment itself using their **equilibrium partitioning coefficients** and their integrated effects can be predicted by applying procedures similar to those applied for integrating sediment quality guidelines. EPA has published procedures for the derivation of equilibrium partitioning sediment benchmarks (ESBs) for the protection of benthic organisms from several classes of contaminants (US EPA - 2001, 2003a, 2003b, 2003c, 2005, 2008). The guidance manual "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures" (EPA/600/R-02/013, November 2003) provides orientation for calculating an integrated ESB for a suite of 34 common PAHs that have been included in various intensive sediment studies, as well as conversion factors to be applied for smaller subsets of 23 and 13 PAHs analyzed in other studies. The suite of PAHs analyzed in DEQ's Estuarine ProbMon Program includes 22 PAHs of the 23-analyte subset for which conversion factors have been provided. Tab (2) - "Dissolved PAH Evaluations" performs the necessary calculations and conversion based on the concentrations of PAHs and total organic carbon (TOC) measured in the sediment. When the converted sum of the 22 individual benchmarks reaches or exceeds 1.0, there is a high probability of adverse chronic effects due to the toxicity of dissolved PAHs. Observations and comments from Tab (2) are copied to the SQT Evaluation Matrix where they contribute to the final weighting of the SQT Matrix score given for sediment chemistry from Tab (1).

An additional tool for the identification of potential sources of PAHs is the ratio between the members of each of two pairs of compounds (Neff et al., 2005). Depending upon the value of the ratio (see Table 5, below), the source may be identified as probably pyrogenic as opposed to petrogenic in origin. Petrogenic PAHs are found in nature, usually at low concentrations; they may be associated with petroleum spills. Pyrogenic PAHs are combustion byproducts, and usually result from the combustion of petroleum products.

Table 5 – The Identification of Pyrogenic vs. Petrogenic Sources of PAH Contaminants based on the ratio of concentrations of Phenanthrene / Anthracene and Fluoranthene / Pyrene (Neff et al., 2005)

Ratio	Value	Probable Source of PAHs
Phenanthrene / Anthracene Ratio	**If <7.0**	**Probably Pyrogenic**
	If >10.0	**Probably Petrogenic**
Fluoranthene / Pyrene Ratio	**If <0.9**	**Possibly Petrogenic**
	If >1.0	**Possibly Pyrogenic**

The Fluoranthene / Pyrene Ratio is much more variable among pyrogenic and petrogenic sources of PAHs than is the Phenanthrene / Anthracene Ratio. Consequently the resultant classification is considered a possible rather than a highly probable source.

Sediment Total Organic Carbon (TOC):
The concentration of total organic carbon in the sediment influences the availability and route of uptake of toxic contaminants by benthic organisms. Organic carbon absorbs or sequesters many organic and inorganic contaminants, and many benthic infauna organisms actively feed on the organic detritus where these contaminants concentrate. Elevated amounts of TOC are consequently considered undesirable for benthic infauna that ingests sediment particulates. Sediment quality indices published in a series of National Coastal Condition Reports (US EPA, 2001, 2005, 2008) classify sediments with more than 5% TOC as being of poor quality. Conversely, because of the equilibrium partitioning of contaminants between sediment carbon and interstitial water, high TOC concentrations in the sediment tend to lower their ESBs and reduce the risk from dissolved toxics that would diffuse across gills and other semi-permeable membranes. Higher TOC concentrations would be beneficial in reducing toxic effects through this route of uptake. Sediment TOC concentration is consequently maintained as an ancillary line of evidence for the interpretation of sediment contamination and is used in the calculation of ESBs on Tab (2).

Sediment Toxicity: Workbook Tab (3)

The magnitude of effects observed during sediment toxicity tests can be applied for weighting this line of evidence. The survival of test organisms, expressed by the percent control-corrected survival or control-corrected mortality endpoint, is generally associated with the acute effects of higher levels of toxicants (although chemical additivity, antagonism and synergism can also play a role). Sub-lethal test endpoints that provide a measure of chronic exposure effects at an increased level of sensitivity, with lower toxicant concentrations, include organism growth (expressed in weight), reburial (amphipods), reproductive rate, etc. In relative terms, the ecological significance of these endpoints is not likely to be as critical as the measure of survival. Therefore, less weight is applied in cases where only these endpoints show effects. In situations where the survival endpoint yields statistically significant effects by one or more species, greater weight would be applied accordingly. It is important to factor the number of test species, their taxonomic identifications and the associated sensitivities of each test species into the weighting. During the tests, attention must also be applied to artificial toxicity such as in the case of naturally occurring sediment ammonia. Another complication is salinity adjustment, which can geo-chemically alter the sediment, thus leading to changes in chemical bioavailability and ultimately affecting sediment toxicity (Roberts et al., 2002). In the field, indigenous predators can also significantly alter the test outcome. Most of these factors are considered and controlled during the performance of toxicity tests in the laboratory .

Toxicity tests performed in compliance with the QAPP of the National Coastal Assessment Program (US EPA, 2001) and continued within the DEQ Estuarine Probabilistic Monitoring Program are currently limited to a single test format with a single test species: ten-day static acute toxicity tests with the amphipod *Ampelisca abdita*, conducted in accordance with standard ASTM guidelines and EPA methods. The specified end-point is amphipod survival. The results of these tests are provided on the "SedTox Data" Tab of the WOE Assessment Workbook and the final evaluation and scoring are carried out on Tab (3) "Sediment Toxicity." Both statistical significance and ecological significance of the results are considered. The statistical significance of test results is tested at a significance level of $\alpha = 0.05$ ($\geq$ 95% confidence that differences from control are real); ecological significance is assumed only if control-corrected survivorship is < 80%. On rare occasion, results may be statistically significant but not ecologically significant, or *visa versa*. In such cases a score of 1 (marginal toxicity) is awarded for evaluation in the SQT matrix.

Ancillary Parameter Values and the Identification of Additional Potential Stressors

Near Bottom Salinity (‰) and Percent Sand (%): The near-bottom salinity class observed at the time of sample collection, and the percent sand in the sediment sample are used in several ancillary evaluations. On the "Summary Sheet" Tab of the WOE Assessment Workbook these two measurements are automatically integrated into a "Habitat Type" characterization for application of the CBP B-IBI on Tab "(4) Benthic Fauna". This integration is also performed by the BEL benthic database at Old Dominion University during the calculation of the CBP Benthic IBI.

In addition, the relative proportions of sand *vs.* fines (silt/clay) in the sediment ("sand" vs. "mud" substrate) can be used to differentiate high energy from low energy benthic environments. Sandy, high energy environments include shallow waters where wave action is more prevalent or deeper channels where significant currents are present. Both are areas where the substrate is at least periodically in movement and fine particulates tend to be washed away. Filter feeders may predominate in such areas, while deposit feeders may predominate in low energy areas where fine particulates accumulate. Substrate type may also serve as an indication of the relative risk of chemical contamination. Contaminants are more readily absorbed, transported and deposited by fine particles (silt/clay) and associated organic detritus than by sand.

Near Bottom Dissolved Oxygen (DO - mg/L) and Depth: Low dissolved oxygen presents a direct stress on benthic fauna. This may result from natural thermal and/or saline stratification that inhibits mixing in deep channels, from nutrient enrichment and eutrophication, or from a combination of both. In warmer, shallower

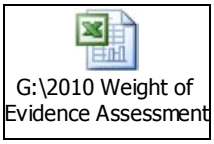
waters low DO concentrations (mg/L) may result simply from its lower solubility at higher temperatures. In either case, the observation of a single low near-bottom DO concentration at a probabilistic site is not sufficient to result in an impaired assessment. It is evaluated only as one among various potential causes for any benthic degradation that is observed.

Bottom Temperature: (^{o}C): Higher water temperature may itself be a significant stressor, in addition to its indirect effect via DO depression.

TOC: As indicated above, the concentration of Total Organic Carbon in the sediment can influence the degree of exposure to and the uptake route of chemical contaminants by benthic organisms. In association with other water quality characteristics, it may also provide insight into the degree of eutrophication present in the estuarine system.

While potential scenarios based on these integrated lines of evidence are too numerous to list, for many sites the conclusion should be obvious. For example, chemical contaminants are commonly detected but at concentrations below their respective SQGs. If the biological results from the same samples indicate a lack of effects, as demonstrated by lack of significant sediment toxicity and the presence of a healthy benthic community, the resultant listing would be VA Category 2A (fully supporting designated use). On the opposite end of the spectrum, all three components of the triad may show extreme effects and the site would consequently be listed in the 5A category (impaired for toxics - needing a TMDL).

An example of a completed WOE workbook is included here to illustrate the final product and provide additional information to help with the Weight-of-Evidence assessment process.



Weight-of-Evidence Workbook – A Completed Example
To open the workbook, double left-click on the icon.

It is preferred that this approach only be applied when all three sediment data components are available from a particular site. It is still possible, however, to implement this process if only two elements are available, as long as data on the condition of the resident benthic community is included (e.g., sediment chemistry and benthic IBI or sediment toxicity and benthic IBI). If both lines of evidence are in agreement as to the condition of the site (e.g., degraded or severely degraded), a corresponding assessment may be attained (i.e., Category 5A with toxics as a potential cause). If such a conclusion is suggested based solely on sediment chemistry and sediment toxicity data, follow-up monitoring should be scheduled (Virginia Assessment Category 3B), even if both chemical and toxicological results are in agreement on the potential existence of a toxic condition. For those instances where the conclusions are not obvious, it will be necessary to obtain consensual agreement between Central Office and the Regional Office responsible for the assessment of that water body. If agreement cannot be attained, advice should be sought from DEQ's Academic Advisory Committee.

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6.5.3 Natural Low DO and pH Evaluation in Swamp Waters

Virginia's list of impaired waters currently identifies many waters as not supporting the aquatic life use due to exceedences of pH and/or DO criteria that are designed to protect aquatic life in Class III waters. However, there is reason to believe that most of these streams or stream segments have been misclassified and should more appropriately be classified as Class VII, Swamp Waters. A procedure for assessing if natural conditions are the cause of the low pH and/or low DO levels in a given stream or stream segment has been developed.

The level of dissolved oxygen (DO) in a water body is determined by a balance between oxygen-depleting processes (*e.g.*, decomposition and respiration) and oxygen-restoring processes (*e.g.*, aeration and photosynthesis). Certain natural conditions promote a situation where oxygen-restoring processes are not sufficient to overcome the oxygen-depleting processes. The level of acidity, as registered by pH in a waterbody, is determined by a balance between organic acids produced by decay of vegetative material and buffering capacity.

Conditions in a stream that would typically be associated with naturally low DO and/or naturally low pH include slow-moving, ripple-less waters. In such waters, the decay of organic matter depletes DO at a faster rate than it can be replenished and produces organic acids (tannins, humic and fulvic substances). These situations can be compounded by anthropogenic activities that contribute excessive nutrients or readily available organic matter to these systems.

The general approach to determine if DO and pH impairments in streams are due to natural conditions is to assess a series of water quality and hydrologic criteria to determine the likelihood of an anthropogenic source. A logical 4-step process for identifying natural conditions that result in low DO and/or pH levels and for determining the likelihood of anthropogenic impacts that will exacerbate the natural condition is described below. DEQ is using this approach to implement State Water Control Law 9 VAC 25-260-55, Implementation Procedure for Dissolved Oxygen Criteria in Waters Naturally Low in Dissolved Oxygen.

Waters that are shown to have naturally low DO and pH levels will be re-classified as Class VII, Swamp Waters, with the associated pH criterion of 3.7 to 8.0 SU. An associated DO criterion is currently being reviewed by the Academic Advisory Committee. A TMDL is not needed for these natural Class VII waters. An assessment category of 4C will be assigned until the waterbody has been re-classified and then re-assessed against the Class VII criteria.

NATURAL CONDITIONS ASSESSMENT FOR LOW DISSOLVED OXYGEN (DO) AND PH

Following a description of the watershed (including geology, soils, climate, and land use), a description of the DO and/or pH water quality problem (including a data summary, time series and monthly data distributions), and a description of the water quality criteria that were the basis for the impairment determination, the available information should be evaluated in four steps.

Step 1. Determine appearance and flow/slope.

Streams or stream segments that have naturally low DO (< 4 mg/L) and low pH (< 6 SU) are characterized by very low slopes and low velocity flows (flat water with low reaeration rates). Decaying vegetation in such swampy waters provides large inputs of plant material that consumes oxygen as it decays. The decaying vegetation in swamp water also produces acids and decreases pH. Plant materials contain polyphenols such as tannin and lignin. Polyphenols and partially degraded polyphenols build up in the form of tannic acids, humic

acids, and fulvic acids that are highly colored. The trees of swamps have higher polyphenolic content than the soft-stemmed vegetation of marshes. Swamp streams (blackwater) are therefore more highly colored and more acidic than marsh streams.

Appearance and flow velocity (or slope if flow velocity is not available) must be identified for each stream or stream segment to be assessed for natural conditions and potential re-classification as Class VII "swamp water". This can be done through maps, photos, field measurements or other appropriate means.

Step 2. Determine nutrient levels.
Excessive nutrients can cause a decrease in DO in relatively slow moving systems, where aeration is low. High nutrient levels are an indication of anthropogenic inputs of nitrogen, phosphorus, and possibly organic matter. Nutrient input can stimulate plant growth, and the resulting die-off and decay of excessive plankton or macrophytes can decrease DO levels.

USGS (1999) estimated national background nutrient concentrations in streams and groundwater from undeveloped areas. Average nitrate background concentrations are less than 0.6 mg/L for streams, average total nitrogen (TN) background concentrations are less than 1.0 mg/L, and average background concentrations of total phosphorus (TP) are less than 0.1 mg/L.

Nutrient levels must be documented for each stream or stream segment to be assessed for natural conditions and potential re-classification as Class VII swamp water. Streams with average concentrations of nutrients greater than the national background concentrations should be further evaluated for potential impacts from anthropogenic sources.

Step 3. Determine degree of seasonal fluctuation (for DO only).
Anthropogenic impacts on DO will likely disrupt the typical seasonal fluctuation seen in the DO concentrations of wetland streams. Seasonal analyses should be conducted for each potential Class VII stream or stream segment to verify that DO is depressed in the summer months and recovers during the winter, as would be expected in natural systems. A weak seasonal pattern could indicate that human inputs from point or nonpoint sources are impacting the seasonal cycle.

Step 4. Determine anthropogenic impacts.
Every effort should be made to identify human impacts that could exacerbate the naturally low DO and/or pH. For example, point sources should be identified and DMR data analyzed to determine if there is any impact on the stream DO or pH concentrations. Land use analysis can also be a valuable tool for identifying potential human impacts. Lastly, a discussion of acid rain impacts should be included for low pH waters.

7Q10 Data Screen

If the data warrant it, a data screen should be performed to ensure that the impairment was identified based on valid data. All DO, temperature or pH data that violate WQ Standards should be screened for flows less than the 7Q10. Data collected on days when flow was < 7Q10 should be eliminated from the data set and the violation rate recalculated accordingly. Only those waters with violation rates determined to be from days with flows ≥ 7Q10 flows should be classified as impaired.

In some cases, data were collected when flow was 0 cfs. If the 7Q10 is identified as 0 cfs as well, all data collected at or above 0 cfs flow would need to be considered in the water quality assessment. In those cases, the impairment should normally be classified as 4C, "impaired due to natural conditions", no TMDL needed. However, a reclassification to Class VII may not always be appropriate.

NATURAL CONDITION CONCLUSION MATRIX

The following decision process should be applied for determining whether low pH and/or low DO values are due to natural conditions and justify a reclassification of a stream or stream segment as Class VII, Swamp Water.

If velocity is low or if slope is low (<0.50%) AND
If wetlands are present along stream reach AND
If no point sources or only point sources with minimal impact on DO and pH AND
If nutrients are < typical background
- ❖ average (= assessment period mean) nitrate less than 0.6 mg/L
- ❖ average total nitrogen (TN) less than 1.0 mg/L, and
- ❖ average total phosphorus (TP) are less than 0.1 mg/L AND

For DO: If seasonal fluctuation is normal AND
For pH: If nearby streams without wetlands meet pH criteria OR if no correlation between in-stream pH and rain pH,

THEN determine as impaired due to natural condition
→ assess as category 4C in next assessment
→ initiate WQ Standards reclassification to Class VII Swamp Water
→ get credit under consent decree

The analysis must state the extent of the natural condition based on the criteria outlined above. A map showing land use, point sources, water quality stations and, if necessary, the delineated segment to be classified as swamp water should be included.

In cases where not all of these criteria apply, a case by case argument must be made based on the specific conditions in the watershed.

EXAMPLE ANALYSIS – pH

Following a description of the watershed (including geology, soils, climate, and land use); a description of the DO and/or pH water quality problem (including a data summary, time series and monthly data distributions); and a description of the water quality criteria that were the basis for the impairment determination, the available information should be evaluated as follows:

- ❖ Step 1: Are there low velocities or low slope? Are there large inputs of decaying vegetation in a wetland that produce acids and lower pH as they decay?
- ❖ Step 2: Are there excessive nutrients instream that can indicate human activity?
- ❖ Step 3: N/A
- ❖ Step 4: Does evidence of human impact through discharges or land use warrant a TMDL?

Example Stream: White Oak Swamp

APPEARANCE/FLOW or SLOPE:
Visual inspection upstream and downstream of bridges at Rt. 156 and Poplar Springs Rd, revealed very swampy conditions usually with standing water in woods on either side of the channel (provide photos and map of area).

The hydrologic slope from the 110 ft topographic contour at rivermile 6.60 downstream to the 50 ft contour at rivermile 1.12 is estimated at 0.21%, considered low slope.

NUTRIENTS:

- Total Phosphorus Av. 0.047 mg/l (n=78)
- Orthophosphorus Av. 0.024 mg/l (n=70)
- Total Kjeldahl Nitrogen Av. 0.61 mg/l (n=78)
- Ammonia as N Av. 0.03 mg/l (n=78)
- Nitrite + Nitrate as N Av. 0.10 mg/l (n=6)

→ Below USGS Average Backgrounds

HUMAN IMPACTS:

- Capital Regional Airport Commission (VA090301) reported pH twice per year for 2000 - 2003 at pH 7.19, 5.10, 6.56, 6.89, 6.44, and 8.44. One pH 4.20 in Aug 2001 during no flow period. Max flow 1357 cfs at Beulah Rd. stormwater outfall during Nov. 2001 to Apr 2002.
- Henrico MS4, 3 General Ind. Minors and 5 Ind. Stormwaters have no pH reporting requirements.
- High Intensity Commercial / Industrial land use comprised 9.0 % of watershed (1586 ac), however only 6.7% pH violations at Beulah Rd, with highest pH values.
- Watershed predominately forested (57.3 percent), with 9.2 percent wetlands and open water.
- Human E. coli impairment at 22% of annual load, therefore it is possible that human activities impact watershed in headwaters.
- Acid rain impact analysis
  - White Oak Swamp is located east of the fall line and an acid rain impact analysis developed for the nearby Mechumps Creek can be applied
  - 10 stations within 17 miles of Mechumps Creek have 2 to 15 years of pH data.
  - If acid rain is an impact, all stations should have low pH impairment, however:
  - 5 stations within 13 miles to the west above the Fall line have higher pH and no impairment (mean pH 6.63 - 7.01); Little, Newfound, and South Anna Rivers, Falling Creek, Stony Run.
  - 5 stations within 17 miles to the east below the Fall line have low pH and natural impairment (mean pH 5.89 - 6.44); Hornquarter, Herring, Totopotomoy, Monquin, and Matadequin Creeks.

CONCLUSIONS:

- Low slope, with predominantly wetlands, not indicative of human impact.
- Low nutrients, not indicative of human impact.
- Human activity above Beulah Rd. can affect pH in headwaters, but there was no observed pH impact downstream at Rt. 156 attributed to the headwaters commercial / industrial land use.
- Low pH is more related to swamp water from low slope swamps below the Fall Line than to acid rain.

→ White Oak Swamp and its tributaries exhibit low pH due to natural conditions and should be re-classified as Class VII, Swamp Water, with the associated pH criterion range of 3.7 to 8 SU. An associated DO criterion is currently being developed from swamp water data. A TMDL is not needed for these waterbodies. An assessment category of 4C will be assigned until the waterbody has been re-classified and then re-assessed.

EXAMPLE ANALYSES - DO

Following a description of the watershed (including geology, soils, climate, and land use); a description of the DO and/or pH water quality problem (including a data summary, time series and monthly data distributions); and a description of the water quality criteria that were the basis for the impairment determination, the available information should be evaluated as follows:

- Step 1: Are there low velocities or low slope? Are there large inputs of decaying vegetation in a wetland that produce acids and lower DO as they decay?
- Step 2: Are there excessive nutrients in-stream that can indicate human activity?
- Step 3: Do seasonal changes lower DO in summer and raise it in winter?
- Step 4: Does evidence of human impact through discharge or land use warrant a TMDL?

Example Stream: Tuckahoe Creek

APPEARANCE/FLOW or SLOPE:
Visual inspection at bridges on Rt. 6 and Rt.650 revealed very swampy conditions. A large wetland named Big Swamp exists for 4 miles above Rt. 6. There are wetlands noted on the land use map along Tuckahoe Creek and Little Tuckahoe Creek from just below Rt. 250 downstream approximately 8 miles to below Rt. 650. Wetlands promote input of decaying vegetation throughout this 8 mile segment, which causes low DO from bacterial decomposition (provide photos and map of area).

The hydrologic slope from the 150 ft topographic contour at river mile 10.55 below Rt. 50 downstream to the 120 ft contour at river mile 2.59 above the old railroad grade below Rt. 650 is estimated at 0.07%, considered very low slope.

NUTRIENTS:
- Total Phosphorus Av. 0.074 mg/l (n=226)
- Orthophosphorus Av. 0.043 mg/l (n=218)
- Total Kjeldahl Nitrogen Av. 0.64 mg/l (n=224)
- Ammonia as N Av. 0.067 mg/l (n=226)
- Nitrite + Nitrate as N Av. 0.31 mg/l (n=23)

→Below USGS average backgrounds, and below background levels in a permitted livestock study by DEQ.

SEASONAL FLUCTUATIONS:
Seasonal fluctuations of DO values where within normal ranges.

HUMAN IMPACTS:
- Henrico Water Treatment Plant (VA0091197) is not required to report DO or CBOD.
- Henrico County MS4 (VA0088617) is not required to report DO or CBOD.
- Two general stormwater permittees, Henrico WTP and Short Pump Town Center, are not required to report DO or CBOD.
- High Intensity Residential, Commercial / Industrial land use comprise 21 % of watershed (8647 ac), located in the eastern portion of the watershed.
- Watershed is predominately forested (52 percent), with 5 percent wetlands / open water.
- Human E. coli impairment is at 12% of annual load, the lowest among three watersheds in Henrico County receiving bacterial TMDLs. However it is still possible that human activities impact watershed.

CONCLUSIONS:
- Low slope, predominantly wetland in impaired segment, not indicative of human impact.
- Low nutrients, not indicative of human impact.
- Normal seasonal DO fluctuation.
- Unknown if DO impact observed at Rt. 6 can be attributed to human activity. Henrico WTP has little impact on DO. The Henrico MS4 has an unknown impact on DO, but discharges following rain events with high velocity, promoting elevated DO from reaeration, and unknown BOD loads. Residential, Commercial / Industrial land use (21%) has suspected effect on watershed.

The impaired segment of Tuckahoe Creek exhibits low DO due to natural conditions and should be re-classified as Class VII, Swamp Water, with the associated pH criterion range of 3.7 to 8 SU. An associated DO criterion is currently being developed from swamp water data. A TMDL is not needed for this waterbody. An assessment category of 4C will be assigned until the waterbody has been re-classified and then re-assessed against Class VII criteria.

Low DO values in the two tributaries appear to be at least partially due to anthropogenic inputs. However, 7Q10 analysis resulted in changed violation rates for two tributaries from 12.1% to 8.9% (Little Tuckahoe Creek) and from 15.9% to 9.6% (Deep Run).

Section 6.6 LAKE and RESERVOIR ASSESSMENT

The current agency guidance on the monitoring and assessment of targeted lakes and reservoirs has been revised and is found in the new Department Guidance Memo No. 09-2005 "Monitoring and Assessment of Lakes and Reservoirs" which can be found at http://www.deq.virginia.gov/waterguidance/wqam.html Section 6.6 provides summary guidance on how to prioritize and assess the many lakes and reservoirs in the Commonwealth for monitoring. This prioritization allows the Department to focus on the most important lakes as they relate to designated uses. Limited resources will then be able to be utilized for these significant lakes and an intensive monitoring schedule can be conducted that will allow a thorough assessment of those significant lakes.

For the 2010 assessment, the lakes and reservoirs which meet the following definition of a "significant lake" will be reviewed as available data allow. A list of the current 127 significant lakes is included in Appendix G of this document.

1. All publicly accessible* public water-supply lakes and/or;
2. All publicly accessible* lakes 100 acres or more in size and/or;
3. The 121 man-made lakes and reservoirs identified under the new nutrient standards for lakes and reservoirs (9 VAC 25-260-187 or §187) and the two natural lakes Mountain Lake and Lake Drummond which have been assigned special Standards for nutrients (9 VAC 25-260-310).

* Publicly accessible means direct access to the water from public property during normal work hours.

The significant lakes determination includes the federally owned lakes which meet these criteria, but all other federally owned lakes would be excluded from the agency lakes monitoring program.

At least one of these two criteria must be met for the lake assessment consideration:

1. lakes and reservoirs should have exceedences of numerical WQ Standards, with actual data observations, as well as confirmation made by more than a single data point, or
2. for any parameters for which DEQ does not have a Water Quality Standard, a loss of designated use (fishable, swimmable, public water supply) documented by ancillary data (such as records of conditions preventing swimming and/or boating, recurrent fish kills and other QA/QC approved non-agency studies or reports, etc.)

Section 6.6.2 incorporates summary guidance from Guidance Memo 09-2005 that document how nutrients and dissolved oxygen data collected from the 121 man-made lakes and reservoirs listed in section §187 and the two natural lakes listed in the special WQ Standards section (9 VAC 25-260-310) will be assessed by DEQ for the 2010 Integrated Report. (If monitoring data are available for assessment of lakes or reservoirs not included in §187, nutrient criteria would not be applicable to such a water body and the water body would not be assessed directly for nutrients but may be reviewed if low DO concentrations have been documented. (see Section 6.6.2 for additional details)

6.6.1 Interpretation/Assessment Issues Unique to Lakes and Reservoirs

The assessor should provide a complete narrative documenting assessment decisions. If uses are impacted, document those uses impacted and how they are impacted. Name causes and sources where possible, (e.g. nuisance algal blooms preventing swimming during summer months, numerous complaints on file or aquatic weed growth preventing free navigation of lake and/or expensive mechanical or chemical clearing, etc).

6.6.2 Nutrient Evaluation of §187 Reservoirs

Both nutrient (chlorophyll *a* and also total phosphorus if there is documented use of algaecides any time during the Department's seven month monitoring period from April through October) and dissolved oxygen/pH data are assessed for aquatic life use. (Bacterial data are used to assess recreational use and observations regarding nuisance algal or plant growths or discolored water are assessed using the general standard as the basis; the recent criteria amendments for lakes and reservoirs did not modify these existing criteria.)

In the 2010 assessment, the Trophic State Index (TSI) evaluation for nutrient impacts in §187 lakes is replaced by newly adopted nutrient criteria. The TSI evaluation will continue to be used in those lakes that are not included in §187.

Assessment for aquatic life (fishery) use of §187 lakes/reservoirs for chlorophyll *a* and total phosphorus (if documented algaecide use):

This assessment procedure for nutrients in §187 lakes replaces the combined TP/DO TSI approach used in 2006 for nutrient assessment relative to assessing natural low DO conditions. However, the TSI approach will be used to determine natural conditions for other non §187 lakes if DO problems have been documented. The nutrient criteria for the 121 man-made lakes and reservoirs listed in §187 of the WQ Standards only apply in the top 1 meter of the lacustrine zone. Lacustrine" means the zone within a lake or reservoir that corresponds to non-flowing lake-like conditions within reservoirs that are deeper than 3 meters (10 feet). The other two zones within a deeper reservoir are riverine (flowing, river-like conditions) and transitional (transition from river to lake conditions). If total phosphorus or chlorophyll *a* data are collected outside the lacustrine zone in the riverine or transitional zone, the data from these two zones will not be used in the assessment for lake or reservoir impairment due to nutrients. As previously stated, the nutrient criteria cannot be used for assessment of lakes and reservoirs that are not listed in §187 of the WQ Standards. For lakes and reservoirs without defined nutrient criteria, but with DO problems, the TSI approach may still be used to determine if those problems are natural.

The regional office staff will base their determination of algaecide use on discussions with the lake owner regarding use of algaecides during the monitoring period and/or DEQ monitoring staff observations of algaecide applications during their monitoring runs on the lake or reservoir. (The intent is to use both chlorophyll a and total phosphorus when algaecides are applied within any zone of the reservoir.)

The 90th percentile of chlorophyll data collected at one meter or less within the lacustrine portion of the man-made lake or reservoir between April 1 and October 31 (considered a lake monitoring year) shall not exceed the chlorophyll *a* criterion for that waterbody in each of the two most recent monitoring years within the assessment window. For a waterbody that received algaecide treatment, the median of the total phosphorus data collected at one meter or less within the lacustrine portion of the man-made lake or reservoir between April 1 and October 31 shall not exceed the total phosphorus criterion in each of the two most recent years that total phosphorus data are available. The aquatic life (fishery) use of any lake (not just the lacustrine zone but rather the entire lake/reservoir) listed in §187 is considered impaired for nutrients if the criterion for either chlorophyll *a* or total phosphorus is exceeded. For each nutrient criterion, chlorophyll *a* and total phosphorus (if documented algaecide use), the assessor will pool all data collected at one meter or less for all months and all stations within the lacustrine portion collected between April and October. Each year must have valid data for 6 of the 7 months of required monitoring to be considered a valid year

Assessment for aquatic life (fishery) use for nutrients in the two natural lakes:

Assessments of the two natural lakes in the special standards section will follow the guidelines above for chlorophyll *a* and total phosphorus except that orthophosphate-P rather than total phosphorus applies to Mountain Lake.

Use of citizen and other external data:
In order to use citizen data in assessments for nutrient impairments, the collector must provide documentation that the data meet QA/QC requirements for chlorophyll a and total phosphorus (orthophosphate-P for Mountain Lake) and that the location of the sampling was within the lacustrine portion of the reservoir and outside the littoral (near shore) zone and corresponds with the lake monitoring year requirements.

6.6.3 Dissolved Oxygen Evaluation

The dissolved oxygen criteria are based on the appropriate criteria established for that class of waters in section 9 VAC 25-260-50. Dissolved oxygen information is used for assessment of aquatic life use.

Assessment for aquatic life use of lakes and reservoirs for the dissolved oxygen criterion:

The 10.5% rule is applicable to 2010 assessments for the minimum dissolved oxygen criterion in all significant lakes and reservoirs for each monitoring year, not just the 121 man-made lakes and reservoirs and two natural lakes included in the recent water quality standards amendments.

For §187 lakes/reservoirs, all dissolved oxygen monitoring observations for all months within the lake monitoring and assessment period at all stations within the constructed reservoir or natural lake are collected in the epilimnion if thermally stratified or throughout the water column if not stratified are assessed against the minimum dissolved oxygen criterion. A lake or reservoir is considered stratified if there is a difference of 1ºC /meter. If the differential is < 1ºC /meter, the lake is not considered stratified. Two or more exceedences and >10.5% exceedence of total samples are required before a water body is listed as impaired for the minimum dissolved oxygen criterion (4 mg/l for most freshwater lakes and reservoirs) under § 62.1-44.19:5 and 7 of the Code of Virginia.

6.6.4 pH Evaluation

The pH criteria are based on the appropriate criteria established for that class of waters in section 9 VAC 25-260-50. pH information is used for assessment of aquatic life use.

Assessment for aquatic life use of lakes and reservoirs for the pH criterion:

The 10.5% rule is applicable to 2010 assessments for the pH criterion range in all significant lakes and reservoirs sampled during the lake monitoring year, not just the 127 significant man-made lakes and reservoirs and two natural lakes included in the recent WQ Standards amendments.

All pH monitoring observations collected for all lake monitoring year months within the assessment period at all stations within the constructed impoundment or natural lake are assessed against the pH criterion range. Two or more exceedences and >10.5% exceedences are required before a water body is listed as impaired for pH. In cases where the applicable nutrient criteria are met for the 121 man-made lakes/reservoirs listed in §187 but the maximum pH criterion is exceeded, the lake or reservoir should be classified as Category 4C and recommended for a WQ Standards review due to natural pH fluctuations. In lakes that are not in §187, the lake/reservoir would be listed as impaired (Category 5A). See lakes/reservoir assessment flowchart below.

6.6.5 Apply Trophic State Index (TSI)

Secchi Depths (SD), Chlorophyll *a* (CA), and Total Phosphorus (TP) will be calculated only on stratified lakes using aggregated station data in the epilimnion from mid-June through mid-September (at 0.3 m for TP and CA) and will be used to determine if DO problems in non §187 lakes and reservoirs.

A trophic state index value of 60 or greater for any one of the 3 indices will indicate that nutrient enrichment from anthropogenic sources are adversely interfering, directly or indirectly, with the designated uses. A TSI value of 60 corresponds to a CA concentration of 20 ug/l, a SD of 1 meter, and a TP concentration of 48 ug/l.

Following are the TSI equations:

TSI(SD) = 10(6 - (ln SD / ln 2))

TSI(CA) = 10(6 - ((2.04 - 0.68 ln CA) / (ln 2)))

TSI(TP) = 10(6 - ((ln (48 / TP)) / (ln 2)))

SD = meters
CA = ug/l
TP = ug/l

The following rules apply:

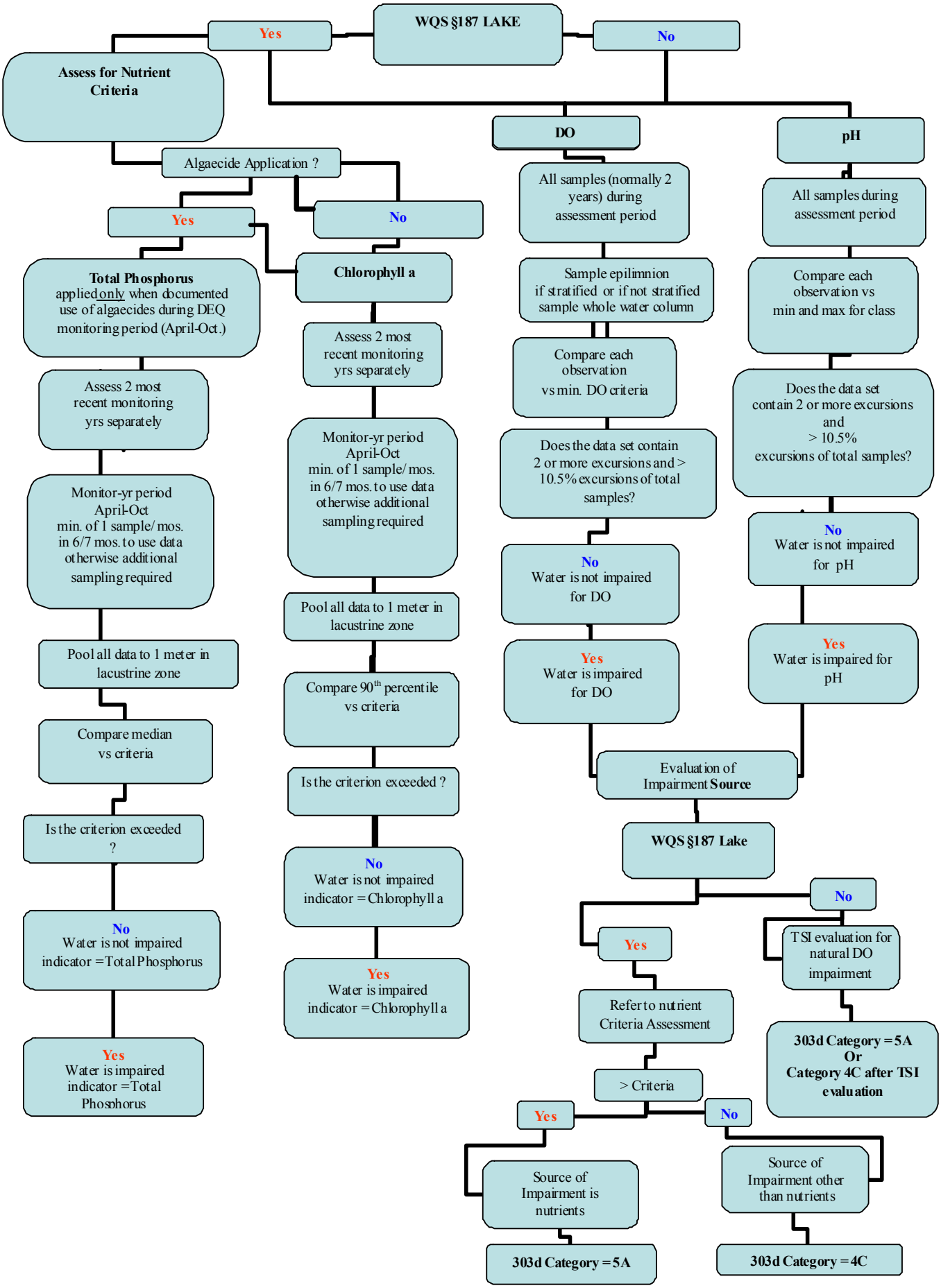
1. Do not calculate a chlorophyll *a* TSI in lakes that are treated with algaecides.
2. The chlorophyll *a* TSI will normally be the preferred indicator in un-treated lakes.
3. Assume that typical Virginia freshwater lakes and reservoirs are phosphorus limited.
4. Do not use the secchi depth index in the assessment if it is much larger than the CA and TP indices in the same assessment unit (prevalence of inorganic matter).
5. The appropriate TSIs should be calculated based on all summer sample data collected in the segment using the spreadsheet that has been developed for easier data processing.

For each monitoring station, if one or more of the TSIs ≥ 60*, the non §187 lake/reservoir will be assessed as impaired partially due to one or more pollutants from anthropogenic sources. The assessment unit or entire lake/reservoir will be placed in category 5A for TMDL development.

For each monitoring station, if each of the TSIs < 60, the lake/reservoir will be assessed as impaired due to pollution from natural sources and placed in category 4C. A TMDL is not needed for the assessment unit represented by the monitoring station(s) and appropriate DO criteria will be developed for the hypolimnion. Based on the results of calculating TSI indices, the reservoir trophic status will be assigned in the Assessment Database (ADB) according to Table 6.

Table 6 Trophic Index

Trophic State	Carlson Trophic State Index	ADB Category
Hypereutrophic	80 – 100	5A
Eutrophic	60 – Less than 80	5A
Mesotrophic	40 – Less than 60	4C
Oligotrophic	0 – Less than 40	4C
Unknown	Insufficient Data	3A


WQS §187 LAKE
Yes
No
Assess for Nutrient Criteria
Algaecide Application ?
Yes
No
Total Phosphorus applied only when documented use of algaecides during DEQ monitoring period (April-Oct.)
Assess 2 most recent monitoring yrs separately
Monitor-yr period April-Oct min. of 1 sample/mos. in 6/7 mos. to use data otherwise additional sampling required
Pool all data to 1 meter in lacustrine zone
Compare median vs criteria
Is the criterion exceeded ?
No
Water is not impaired indicator = Total Phosphorus
Yes
Water is impaired indicator = Total Phosphorus
Chlorophyll a
Assess 2 most recent monitoring yrs separately
Monitor-yr period April-Oct min. of 1 sample/mos. in 6/7 mos. to use data otherwise additional sampling required
Pool all data to 1 meter in lacustrine zone
Compare 90th percentile vs criteria
Is the criterion exceeded ?
No
Water is not impaired indicator = Chlorophyll a
Yes
Water is impaired indicator = Chlorophyll a
DO
All samples (normally 2 years) during assessment period
Sample epilimnion if stratified or if not stratified sample whole water column
Compare each observation vs min. DO criteria
Does the data set contain 2 or more excursions and > 10.5% excursions of total samples?
No
Water is not impaired for DO
Yes
Water is impaired for DO
pH
All samples during assessment period
Compare each observation vs min and max for class
Does the data set contain 2 or more excursions and > 10.5% excursions of total samples?
No
Water is not impaired for pH
Yes
Water is impaired for pH
Evaluation of Impairment Source
WQS §187 Lake
Yes
Refer to nutrient Criteria Assessment
> Criteria
Yes
Source of Impairment is nutrients
303d Category = 5A
No
Source of Impairment other than nutrients
303d Category = 4C
No
TSI evaluation for natural DO impairment
303d Category = 5A Or Category 4C after TSI evaluation

Section 6.7 COASTAL ASSESSMENT

Virginia has 120 miles of Atlantic Ocean coastline and approximately 2,500 square miles of estuary. This resource has a prominent place in Virginia's history and culture. It is valued for its commercial fishing, wildlife, sporting, and recreational opportunities, as well as its commercial values in shipping and industry. In the 1970's adverse trends in water quality and living resources were noted and prompted creation of the Federal-Interstate Chesapeake Bay Program (CBP). The coastal assessment is conducted in the same manner as the estuarine assessments previously described in Sections 6.4.1.2 and 6.5.3.2. Additionally, the recently enacted federal BEACH program, which is being implemented by the VDH, has begun collecting recreational use data during the swimming season and assessment of this data is being incorporated into the Integrated Report. Additional coastal monitoring is being planned to compliment the next federal coastal monitoring and assessment planned for summer 2010.

Section 6.8 WETLANDS ASSESSMENT METHODOLOGY

Background:
Impacts to tidal wetlands, including vegetated tidal wetlands and non-vegetated shoreline between mean low and mean high water, are regulated under the Virginia Tidal Wetlands Act (Title 28.2, Chapter 13 of the Code of Virginia) enacted in 1972 and revised in 1982. The Virginia Marine Resources Commission (VMRC) is the regulating authority for the tidal wetlands laws while localities in Tidewater Virginia have the option to regulate their own tidal wetlands through citizen Wetlands Boards with oversight from VMRC. The Virginia Department of Environmental Quality (DEQ) is responsible for providing Section 401 Certification of Clean Water Act for Section 404 federal permits for tidal and nontidal wetlands and water withdrawals, through the Virginia Water Protection Permit (VWPP) Program, first developed in 1992. In 2000, Virginia passed a Nontidal Wetlands Act that amended Title 62.1 of the Code of Virginia relating to wetlands. The Nontidal Wetlands Act mandates that the Commonwealth implement a nontidal wetlands regulatory program to achieve no net loss of existing wetland acreage and function, and to develop voluntary and incentive based programs to achieve a net resource gain in wetlands. Amendments to the VWPP program, fully implemented in October 2001, provide additional state jurisdiction and require a state permit for the following activities in a wetland: excavation, filling or dumping, activities in a wetland that cause drainage or otherwise significantly alter or degrade existing wetland acreage or function, and permanent flooding or impounding. Additional amendments to the VWPP program, fully implemented in July 2007, provide clarifications of state jurisdiction of small water withdrawals, incorporate several provisions of the Local and Regional Water Supply Planning regulation, and address water supply permitting and surface water withdrawal concerns. Further amendments to the VWPP program, fully implemented in December 2008, provide exclusion of certain in-stream fills for water supply on agricultural properties. The VWPP can serve as the Section 401 certification of a federal permit or as a state permit when no federal permit is required. The VWPP can also serve as the federal permit if the project qualifies for coverage under the State Program General Permit program, first issued to the Commonwealth in 2002. The permit process for both tidal and nontidal wetlands relies on a Joint Permit Application (JPA) which receives independent and concurrent review by local wetlands boards, VMRC, DEQ and the U.S. Army Corps of Engineers (Corps), as appropriate.

By statute and by regulation, Virginia adopted the same definition of wetlands as the federal definition, and requires that wetlands be defined in the field using the Corps' 1987 Manual. Specifically, wetlands are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." Wetlands are part of state waters, which are defined as "all water, on the surface and under the ground, wholly or partially within or bordering the Commonwealth or within its jurisdiction, including wetlands."

Tidal wetlands are defined to include tidally influenced areas within Tidewater Virginia contiguous to mean low water extending landward to an elevation 1 1/2 times the mean tide range at a site and upon which is growing

certain listed plant species. They also include "non-vegetated wetlands" which include unvegetated lands between mean low water and mean high water tides.

Section 62.1-44.15:21 of the Code of Virginia specifies that the state utilize the Corps' Wetlands Delineation Manual (Technical Report Y-87-1, January 1987, Final Report) as the approved method for delineating wetlands, and that the state shall adopt appropriate guidance and regulations to ensure consistency with the Corps' implementation of delineation practices.

Purpose:
The overall wetland monitoring strategy is to establish baseline conditions in various broad contexts, including land use, watershed, and wetland type. This information can then be used to guide management decisions regarding wetland restoration efforts, programmatic compensatory mitigation, and integration with overall WQ Standards. This strategy provides the ultimate framework for an ongoing assessment of the status of the Commonwealth's wetland resources and the success of both wetland regulatory and voluntary programs. The wetlands monitoring strategy will be coordinated with Virginia's comprehensive water quality monitoring program strategy. The monitoring objectives are designed to support regulatory decision-making, allow reporting of wetland conditions, and provide information for policy development.

The wetland monitoring program will also meet the Clean Water Act objectives for water monitoring programs by addressing the quality of the Commonwealth's wetlands and their condition as part of the overall condition assessment of state waters.

DEQ is preparing a strategic plan for integrating existing and new programs into wetland monitoring. The plan will include tasks to accomplish, timelines for their completion, budget needs, and plans for funding these initiatives. This strategy will provide the ultimate framework for an ongoing assessment of the status of the Commonwealth's wetland resources and the success of both our wetland regulatory and voluntary programs. The end result will be the incorporation of on-going wetland monitoring and assessment into the Commonwealth's water monitoring programs.

Wetlands Assessment:
Virginia continues to make significant progress in the development and refinement of a hierarchical suite of assessments that constitute a three level approach to wetlands sampling and analysis. Comprehensive coverage of all mapped wetlands is achieved with a GIS based analysis of remotely sensed information (Level 1 analysis). These data are summarized on the basis of small watersheds or hydrologic units. It provides a first order evaluation of the condition and functional capacity of wetlands based on their landscape position.

The second level assessment is intended for use in a statistically selected sub-sample of the watershed wetland population and involves a more sophisticated analysis of remotely sensed information and a site visit for verification and additional data collection. The third level assessment involves very detailed analysis of wetland performance of specific functions (i.e., habitat and water quality). This involves extensive sampling of a limited number of sites, specifically chosen to allow validation of the conceptual model of wetland function that underlies the Level 1 and Level 2 assessments.

Monitoring Program Development:
The DEQ wetlands program, in coordination with the overall DEQ water quality monitoring program, has developed a ten-year plan for wetland monitoring and assessment in Virginia. This work is being accomplished as work products under EPA State Wetland Development Grants CD-983380-01, CD 983815-01, BG 983924-4, and BG-983925-01, BG-98392502, and BG-98392503 to the Department of Environmental Quality. The development of this strategy follows the EPA October 2002 draft document "Elements of a Wetland Monitoring and Assessment Program Checklist," Application of Elements of a State Water Monitoring and Assessment Program for Wetlands" (USEPA, April 2006) and will include a discussion of the following 'Ten Essential Elements of a State Water Monitoring and Assessment Program' (USEPA, March 2003):

1. Monitoring Program Strategy
2. Monitoring Objectives
   Information derived from monitoring will be used to:

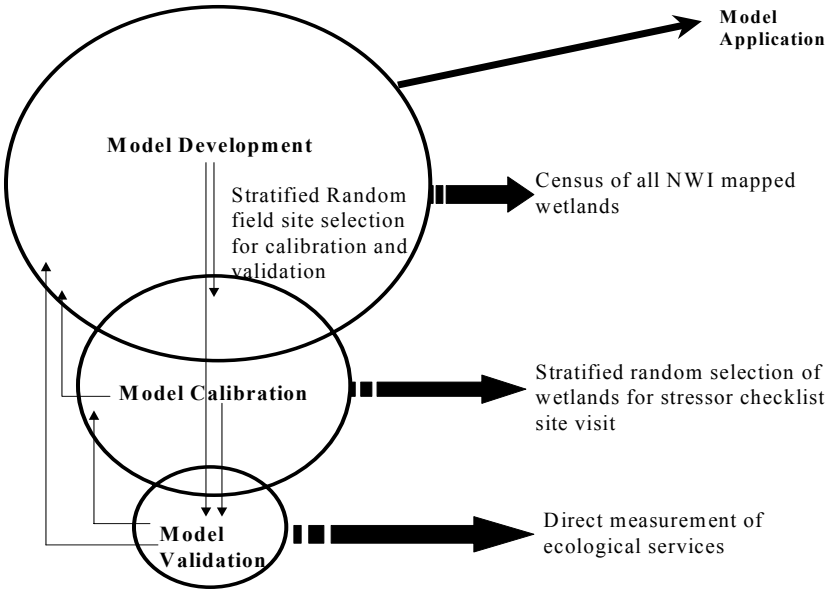
   - Report ambient wetland conditions in Virginia's Clean Water Act (CWA) Section 305(b) reports;
   - Assist in the evaluation of environmental impacts of proposed impacts to wetlands during permit review as part of Virginia's regulatory program;
   - Evaluate the performance of wetland restoration and compensatory wetland mitigation in replacing wetland acreage and function; and
   - Evaluate the cumulative impacts of wetland loss and restoration in watersheds relative to ambient ecological conditions.
3. Monitoring Design
4. Core and Supplemental Water Quality Indicators
5. Quality Assurance
6. Data Management
7. Data Analysis/Assessment
   Examples of different wetland quality data analyses may include:

   - Comparison of wetland quality within a watershed and between watersheds
   - Comparison of wetland quality within a locality and between different localities
   - Comparison of wetland quality within a watershed or locality over time
   - Comparison of wetland quality between wetland types
   - Correlation of wetland type and specific stressor
   - Comparison of wetland quality within and between hydrogeomorphic (HGM) classes
   - Comparison of wetland quality within a specific wetland over time
8. Reporting
9. Programmatic Evaluation
10. General Support and Infrastructure Planning

As part of the overall development of a wetland monitoring and assessment strategy, an interagency committee of other state agencies involved in wetland issues, including the Virginia Marine Resources Commission, the Department of Game and Inland Fisheries, and various programs within the Department of Conservation and Recreation was established. This interagency committee reviewed and commented on the monitoring and assessment strategy, and will provide periodic updates on what other agencies are doing with regard to wetland resources. Further, DEQ and VIMS have collaborated with EPA and academic institutions to peer review the monitoring design and data collection/analysis portions of the project. Further, all work has been and will continue to be closely coordinated with other EPA-Region III nontidal wetlands programs through the Mid-Atlantic Wetlands Workgroup (MAWWG) of which Virginia is a member, as well as with EPA headquarters and other regions through active participation in EPA's National Wetlands Monitoring Workgroup.

The protocol for wetland monitoring and assessment developed in Virginia consists of a multi-tiered sampling design coupled with methods for regulatory updates and field office data delivery (see Figure 3 below). Each assessment level informs the other levels, and is essential in development of the final assessment protocol.

Figure 3. Multi-tiered sampling design.



To date, model development (Level I) and model calibration (Level II) has been completed for Virginia Model validation (Level III) has been completed in the Coastal Plain. By December 2008, we plan to begin model validation (Level III) for Piedmont, Valley and Ridge, Blue Ridge, and Appalachian Plateau, and to begin modeler-sample (Level II) in the coastal plain subset for calibration. The elements of Virginia's wetland monitoring and assessment program are listed in Table 7 below.

Table 7 - Wetland Monitoring and Assessment Program Elements	
Monitoring Strategy	1. Establish baseline condition of nontidal wetlands by broad category scalable from individual wetland to small watershed to physiographic province to entire State. 2. Guide management decisions regarding restoration, compensation, and regulation of wetlands.
Monitoring Objectives	1. Support regulatory decision-making. 2. Report wetland condition. 3. Guide policy development. 4. Evaluate cumulative impacts of wetland loss. 5. Evaluate wetland restoration and compensatory mitigation effectiveness.
Survey Design	Three-Tiered: Sample Frame = all NWI wetlands 1. Enhanced GIS analysis (census) – Level I (Model Development). 2. Probability-based sampling for field assessment of anthropogenic stressors – Level II (Model Calibration). 3. Intensive study of biological endpoints (birds, amphibians, water quality) along stressor gradient – Level III+ (Model Validation).
Assessment Indicators and Methods	1. Level I (Model Development): land use adjacent, within 200m, and within 1000m of wetland, wetland size, type, hydroperiod, proximity to other wetlands, road type, road density, and road

	alignment. 2. Level II (Model Calibration): field assessment of anthropogenic stressors within 30m of wetland assessment point and within 100m of wetland assessment point. 3. Level III (Model Validation): population and community structure metrics for birds and amphibians. Water quality modification metrics.
Quality Assurance	An EPA-approved Quality Management Plan coupled with the Center Quality Assurance Plan used to prevent random and systematic errors. Techniques include direct electronic field data assimilation to prevent transcription error as well as random return site visits and redundant QA assessment loops.

Virginia has completed Phase 1 through 3 of the wetland inventory and monitoring strategy (see Table 8 below). Phase 1 was designed to take the initial steps toward reaching the goal of assessing the location, extent and general quality of the Commonwealth's nontidal wetlands and supporting a comprehensive database to track wetland losses and gains. Phase 1 also involved the development of a long-term strategy for wetland monitoring and assessment, including the goals and objectives of a state wetland monitoring and assessment program and a time frame for implementation. The strategy developed in Phase 1 provides the framework for the ongoing assessment of the status of the Commonwealth's wetland resources and performance measures for both the wetland regulatory and voluntary programs.

With the completion of Phase 1, the development of a model for an assessment (Level I) that provides a comprehensive coverage of all mapped wetlands (approximately 222,000 wetland units- polygons, arcs, points) by small watersheds utilizing a GIS-based analysis of remotely sensed information has been completed for the entire Commonwealth. In addition, model calibration (Level II) sampling of the Coastal Plain and Piedmont has been completed. The level I (model development) analysis, combined with validation and calibration from the level II and level III assessments, will provide an evaluation of the condition of wetlands based on their position in the landscape. This information is directly applicable to status and trends reporting under Clean Water Act Section 305(b), and can be utilized in permitting programs to assess cumulative impacts to wetlands within watersheds.

Level II sampling (calibration) was conducted on 198 sites in the Valley and Ridge, Blue Ridge, and Appalachian Plateau. Due to the recognized deficiency of the NWI dataset in locating wetlands within these physiographic provinces, a methodology to enhance the sample frame was developed in partnership with Virginia Tech (Appendix I). The analysis provides information on improving the location of wetlands in the Ridge & Valley region and supports the present stressor/wetland condition relationship. The number of sites in the Level II calibration allows a sufficient sample size to generate a statistically robust assessment of wetland condition throughout the Valley and Ridge, Blue Ridge, and Appalachian Plateau and allow for Level III site selection in these provinces.

Table 8: Long-term Wetlands Field Assessment Strategy for Virginia			
Phase 1	Oct. 2003	Begin Level I assessment for Virginia.	Complete
	Dec. 2004	Begin Level II site assessment of Coastal Plain wetlands.	Complete
	Dec. 2005	Complete Level I assessment of Virginia, Complete Level II site assessment of Coastal Plain, Develop protocol for Level III assessment for Coastal Plain physiographic province.	Complete

Phase 2	Dec. 2005	Begin Level II site assessment of Piedmont physiographic province.	Complete
	Sept. 2007	Complete Level II site assessment of Piedmont. Begin Level III sampling for coastal plain sites.	Complete
Phase 3	Oct. 2007 – Sept. 2008	Complete enhanced wetland site selection for Valley and Ridge, Blue Ridge, and Appalachian Plateau Level II site assessment using a protocol for probable wetlands location. Complete Level II site assessment for Valley and Ridge, Blue Ridge, and Appalachian Plateau physiographic provinces. Continue Level III sampling for Coastal Plain.	Complete
Phase 4	Oct. 2008 – Sept. 2010	Begin Level III (model validation) sampling for Piedmont, Valley and Ridge, Blue Ridge, and Appalachian Plateau. Begin Level II re-sample coastal plain subset for calibration.	In Progress
Phase 5	Oct. 2011	Begin Level I re-sample of Virginia for trends analysis.	Unfunded

The additions of data sets and GIS layers will allow Virginia to continue to develop a GIS-based wetland data viewer for use by regulatory agencies and the general public (see Figure 4). Our success will be measured by an increasing trend in the statistically-reliable Level I protocol and a decreasing trend in cumulative wetland impacts. By having a statistically-validated tool that measures wetland quality as a function of habitat and water quality parameters, our permit staff will be able to make better permit decisions relative to potential cumulative impacts. Further, we will also be able to measure how well we are protecting the function of our more vulnerable wetlands (i.e. isolated wetlands, vernal pools, white cedar swamps), by comparing the condition of wetland habitat and water quality parameters, as a function of the assessment scoring over time.

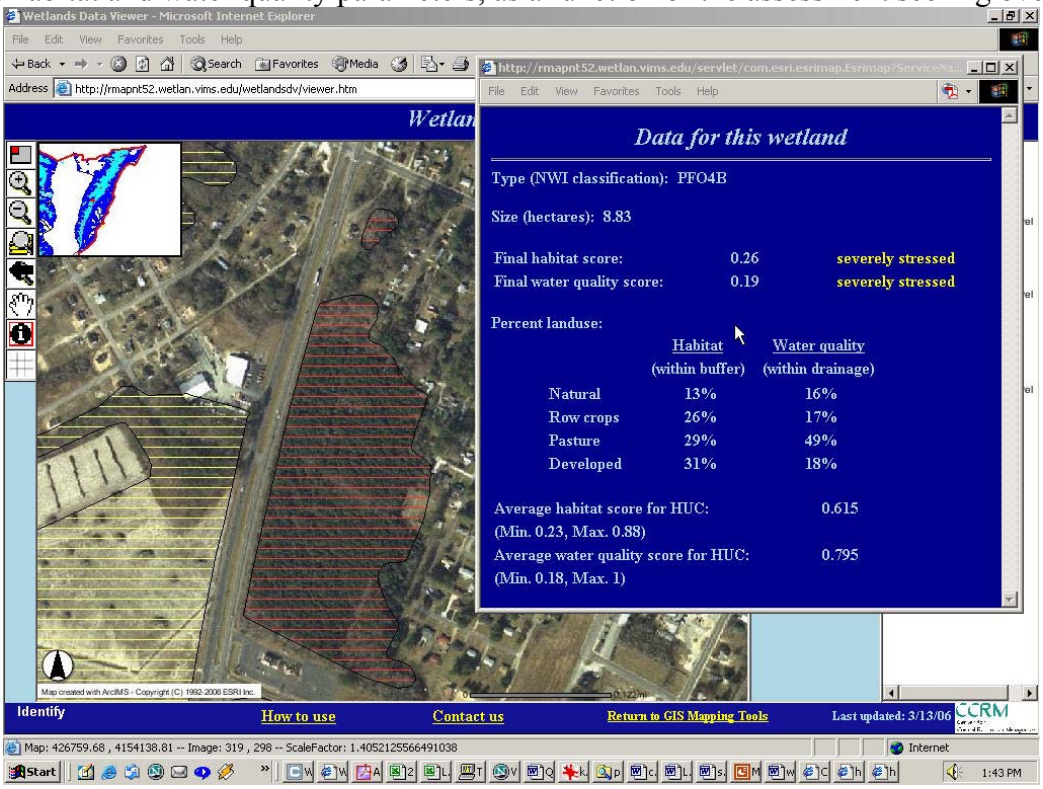


Figure 4: Wetlands Data Viewer Development

The wetland data viewer illustrated above is currently under design modifications and testing, and is not expected to be available for general use until late 2009 or early 2010. The overall outcome of this continued

focus on wetland monitoring and assessment will be better protection of wetlands and more definitive and defensible information on wetland condition over time and documentation of how we are achieving no net loss of wetland acreage and function in Virginia.

For the 2010 integrated report, the wetland program will include Level 1 wetland monitoring and assessment data for the entire state, and Level 1, 2 and 3 data for the coastal plain. This data will identify the condition of our wetlands and show that the data is more precise in the coastal plain. Level 1 data will be more precise in the physiographic regions of the remainder of the state as Level 2 and 3 are completed.

Section 6.9 FRESHWATER PROBABILISTIC ASSESSMENT

The freshwater probabilistic monitoring program is designed to allow Virginia DEQ make estimates of water quality with known confidence for 100% of Virginia's freshwater stream miles. Freshwater probabilistic monitoring is not designed to make segment/assessment unit decisions. However, a small number of parameters collected at probabilistic sites can be used to determine use support for that site.

The following parameters will be used for assessment unit decisions:

1) Dissolved Oxygen (if 2 out of 2 violate standard for stream class)
2) pH (if 2 out of 2 violate standard for stream class)
3) Temperature (if 2 out of 2 violate standard for stream class)
4) Virginia Stream Condition Index – Using the guidance set forth in the freshwater benthic assessment guidance.

PART VII 303(d) LISTING/DELISTING and TMDL PRIORITY RANKING

Section 7.1 "EFFLUENT LIMITED" and ALTERNATIVE CONTROL WATERS (Category 4B/5E)

Rule 1

When reviewing waters receiving effluent from facilities with water quality based effluent limits in VPDES permits, the following should be considered in developing the 303(d) list;

1. If the permit has been issued with no compliance schedule and the limits are to be met upon permit issuance, then listing is not necessary.

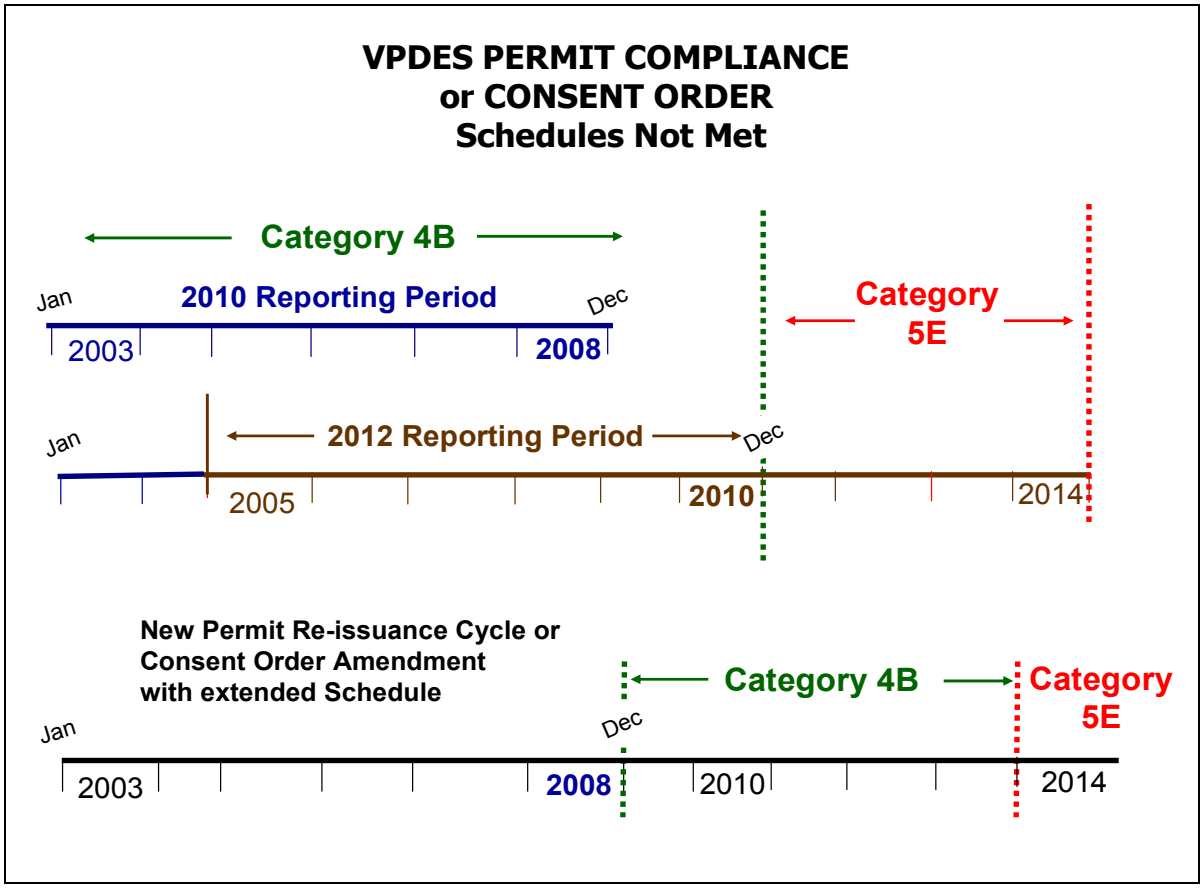
2. If the permit for a previously listed water has since been issued with no compliance schedule and the limits are required to be met upon permit issuance, then delist the facility. EPA must be provided a verification package for delisting waters (see Section 7.1 Rule 2).

3. If achievement with the existing permit compliance schedule or consent order has not occurred by the end of the 2010 reporting period (12/31/08) and the permit is still in effect but is anticipated to meet the schedule by the end of the 2012 reporting period (12/31/10) it is Category 4B.

4. If the existing permit expiration date does not extend past the 2010 ending date (12/31/08) and the compliance schedule or consent order compliance date extends beyond the 2012 reporting period ending (12/31/10) it is Category 5E.

5. If a permit re-issuance occurs with a compliance or consent order schedule after the 2010 ending date (12/31/08) but prior to the 2012 ending date (12/31/10):

a. And compliance with the previous permit compliance or consent order schedule was not achieved.
b. And a new compliance schedule or consent order date extends beyond the 2012 reporting ending date (12/31/10) up to 12/31/13. Then the water is Category 4B based on the five year permitting cycle.
c. If a staged or phased permit compliance schedule (greater than the permit five year cycle) or consent order extends beyond 12/31/13 then the water is Category 5E.



Rule 2

The verification process for removing or delisting effluent limited waters must consider the following;

- The removal or delisting process applies only to waters impacted by a single point source discharge. TMDLs will have to be developed and approved by EPA prior to delisting waters impacted by multiple discharges or a single point source with a significant nonpoint source "load allocation" component. A water listed in Part II for NH3-N discharging into a segment listed for nonpoint source fecal coliform bacteria could be removed since the bacteria problem is unrelated to the NH3-N.

- If compliance with the Water Quality (WQ) based effluent limits is not met by the compliance date, the waters should not be removed from the list or should be relisted in Category 4B if previously removed and a new compliance schedule requiring compliance by the end of the next reporting period is in place. If a new compliance schedule has not been negotiated or extends past the next reporting period, the water should be listed as Category 5E. If post operational water quality data shows that WQ Standards are not being met, the water should remain on the list or be relisted in Category 5A.

If the above conditions are met, the following information should be submitted to EPA for delisting those waters identified in Category 4B of the 2010 303(d) Report. Waters that do not meet the above conditions should be listed or remain in Category 4B of the 2010 303(d) Report.

Verification Packet for VPDES Permits:
Hydrologic Unit Code (HUC), Watershed Identity Number, Stream Name, Parameter, and VPDES Permit Number, Owner/Facility Name and recent DMRs showing compliance.

- A statement identifying the basis for delisting the water. The statement should confirm that water quality based effluent limits were in place by the compliance date, and these effluent controls are sufficient to attain or maintain WQ Standards. If the facility will meet the water quality based effluent limits within the listing cycle required by federal law and WQ Standards are expected to be attained or maintained, the verification should describe the facility's progress in meeting the effluent requirements and the expectation that the compliance date in the permit will be met.

- Copy of water quality analysis modeling conducted as part of permit development that shows the level of controls necessary to implement WQ Standards.

- Copy of permit page (and/or any State compliance order and associated interim limits and schedule to achieve the final limit) that contains the required control levels.

- Copy of permit page that provides the compliance date for water quality based controls.

Rule 3

Category 4B – Alternative Control

EPA's 2006 IR Guidance acknowledged that the most effective method for achieving water quality standards for some water quality impaired segments may be through controls developed and implemented prior to the TMDL development and/or implementation (referred to as a "4B alternative"). DEQ requests EPA to evaluate, on a case-by-case basis, the Commonwealth's decisions to exclude or delist certain segment/pollutant combinations from Category 5 (the section 303(d) list) based on the 4B alternative. A 4B rationale will be provided to EPA in the submission of the 2010 IR which supports the Commonwealth's conclusion that there are "other pollution control requirements" sufficiently stringent to achieve applicable water quality standards within a reasonable period of time.

Required elements of the 4B rationale:
Specifically, this rationale should include:
(1) a statement of the problem causing the impairment,
(2) a description of the proposed implementation strategy and supporting pollution controls necessary to achieve water quality standards, including the identification of point and non-point source loadings that when implemented assure the attainment of all applicable water quality standards,
(3) an estimate or projection of the time when water quality standards will be met,
(4) a reasonable schedule for implementing the necessary pollution controls,
(5) a description of, and schedule for, monitoring milestones for tracking and reporting progress to EPA on the implementation of the pollution controls, and
(6) a commitment to revise, as necessary, the implementation strategy and corresponding pollution controls if progress towards meeting water quality standards is not being shown.

Section 7.2 IMPAIRED WATERS (Category 5)

Rule 1

Waters listed as impaired and needing a TMDL in the Integrated Report will remain on the list and tracked in subsequent Integrated Reports until:

- An EPA approved TMDL is developed for all pollutants causing impairment

OR

A subsequent assessment of new monitoring data or in special cases, modeling results show that the water is no longer impaired and EPA approves the delisting of the water. (see Section 7.2 Rule 2 for necessary delisting documentation)

Rule 2

Documentation required by EPA for delisting previously listed impaired waters that are now restored:

Scenario # 1: when new data demonstrates a previously impaired waterbody is currently attaining WQ Standards, DEQ should submit the following documents to justify the delisting of this segment from the next 303(d) list.

- Hydrologic Unit Code (HUC), Federal TMDL ID (if available), Cause Group Code, Watershed Identity Number, Stream Name and Listed Parameter
- Rationale for the decision to remove the previously impaired segment from the next 303(d) list
- Copies of the data that are being used to justify the removal of the segment
- Copies of the previous data which were used to list the segment
- Any differences between the sampling techniques should be documented and submitted
- A description of the water including but not limited to: stream name, impaired miles (acres or sq. mi.), beginning and ending river miles, impairment, watershed identification code and HUC

Scenario # 2: when new water quality modeling determines the stream is now attaining WQ Standards, DEQ should submit the following documents to justify the removal of this segment from the next 303(d) list.

- Hydrologic Unit Code (HUC), Federal TMDL ID (if available), Cause Group Code, Watershed Identity Number, Stream Name and Listed Parameter.
- Rationale for the decision to remove the previously impaired segment from the next 303(d) list
- Submission of any new data that were used in the modeling
- A copy of the EPA approved model that was used. A summary of the differences between the new and the old models. The reasons why the stream attains WQ Standards under the new model opposed to the former model (data, modeling assumptions, modeling applications, etc)
- A description of the water including but not limited to: stream name, impaired miles (acres or sq. mi.), beginning and ending river miles, impairment, watershed identification code and HUC

Scenario # 3: when new management practices from point and/or nonpoint sources lead to the attainment of WQ Standards, DEQ should submit the following documents to justify the removal of this segment from the next 303(d) list.

- Hydrologic Unit Code (HUC), Federal TMDL ID (if available), Cause Group Code, Watershed Identity Number, Stream Name and Listed Parameter.

- Rationale for the decision to remove the previously impaired segment from the next 303(d) list.
- Submission of the most recent 2 years of water quality data that indicate the water is a candidate for delisting and
- A description of the new management practices and other changes that have occurred in the watershed to explain the change in water quality.
- A description of the water including but not limited to: stream name, impaired miles (acres or sq. mi.), beginning and ending river miles, impairment, watershed identification code and HUC.

The TMDL staff should apply the Proactive Approach, as appropriate, any time a TMDL is scheduled for development. Appendix D contains additional procedural information on this approach.

Scenario # 4: when errors are detected in the rationale for the initial listing of the segment or WQ Standards have been modified and the segment is attaining WQ Standards, DEQ should submit the following documents to justify the removal of this segment from the next 303(d) list.

- Hydrologic Unit Code (HUC), Federal TMDL ID (if available), Cause Group Code, Watershed Identity Number, Stream Name and Listed Parameter.
- Rationale for the decision to remove the previously impaired segment from the next 303(d) list
- Documentation of the errors in the initial listing
- A copy of the data and/or modeling that demonstrates the segment attains WQ Standards at least 90% of the time
- A description of the water including but not limited to, stream name, impaired miles (acres or sq. mi.), beginning and ending river miles, impairment, watershed identification code and HUC

In certain cases EPA may request additional documentation to justify the removal of the segment from the 303(d) list.

Rule 3

Impaired bacteria waters falling geographically within an EPA approved TMDL bacteria study area and having assigned pollutant loadings should be identified, incorporating the Federal TMDL ID (if available) and Cause Group Code into ADB and the TMDL database for the assessment unit and subsequently listed as Category 4A (impaired and TMDL has been completed and EPA approved). For benthic impairments within an EPA approved benthic TMDL, professional justification and documentation is necessary indicating the new impairment is covered by the approved TMDL allocations.

Rule 4

Section 303(d) requires States to "establish a priority ranking" for the waters it identifies on the impaired waters list, taking into account the severity of the pollution and the uses to be made of such waters, and to establish TMDLs "in accordance with the priority ranking." Federal regulations provide that "schedules for submissions of TMDLs shall be determined by the Regional Administrator and the State" (40 CFR 130.7(d)(1)). Other reasonable factors such as the State's use of a rotating basin approach or commitments specified in court orders or consent decrees may also be considered when States develop priorities and schedules.

For the waters covered by the June 1999 Consent Decree pertaining to Virginia's TMDL program, DEQ has developed a TMDL development schedule ending on May 1, 2010. For waters listed as impaired subsequent to the Consent Decree, TMDLs are expected to be completed within 12 years of the first listing date. Outside of the specific TMDL development schedule, TMDL due dates assigned to each water body reflect the date when a TMDL must be established. However, if subsequently listed waters are within a Consent Decree watershed, every effort will be made to address the impairments at the same time. This may result in TMDL development

much sooner than the 12 years generally anticipated. Also, in response to concerns raised by the United States Fish and Wildlife Service during the development of the 2002 303(d) List, certain impaired waters of concern to them have accelerated TMDL development dates.

In preparing the TMDL development schedule, Virginia does not specifically identify each TMDL as high, medium or low priority. Instead, DEQ uses the TMDL schedule itself to reflect Virginia's priority ranking. The CWA does not prescribe a particular method of expressing a priority ranking, and DEQ believes a TMDL schedule is a reasonable, efficient way to demonstrate priority ranking.

In scheduling TMDLs for development, every effort should be made to address all related impairments in a watershed at the same time. If endangered species are affected by an impairment listing, TMDL development should be scheduled as expeditiously as possible. If a public water supply is affected by an impairment listing, TMDL development should be scheduled as expeditiously as possible. In the absence of impacts to public water supplies or endangered species, a watershed approach should be used for TMDL development scheduling. Other factors that may impact TMDL scheduling include public interest and support, locally available funding to implement controls, or coordinating TMDL development efforts with an adjoining state.

After the TMDL schedule has been developed, the order in which TMDLs are established might be subject to some modifications to accommodate logistical efficiencies or data availability. The process is a dynamic process and any priority ranking may be changed if substantial factors change or become apparent during the scheduling process.

APPENDIX A

Clean Water Act Sections

SEC. 305. WATER QUALITY INVENTORY

(b) (1) Each State shall prepare and submit to the Administrator by April 1, 1975, and shall bring up to date by April 1, 1976, and biennially thereafter, a report that shall include—

(A) a description of the water quality of all navigable waters in such State during the preceding year, with appropriate supplemental descriptions as shall be required to take into account seasonal, tidal, and other variations, correlated with the quality of water required by the objective of this ACT (as identified by the Administrator pursuant to criteria published under section 304(a) of this Act) and the water quality described in subparagraph (B) of this paragraph;

(B) an analysis of the extent to which all navigable waters of such State provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water;

(C) an analysis of the extent to which the elimination of the discharge of pollutants and a level of water quality which provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows recreational activities in and on the water, have been or will be achieved by the requirements of this Act, together with recommendations as to additional action necessary to achieve such objectives and for what water such additional action is necessary;

(D) an estimate of (1) the environmental impact, (ii) the economic and social costs necessary to achieve the objective of this Act in such State, (iii) the economic and social benefits of such achievement, and (iv) an estimate of the date of such achievement; and

(E) a description of the nature and extent of nonpoint sources of pollutants, and recommendations as to the programs which must be undertaken to control each category of such sources, including an estimate of the costs of implementing such programs. (2) The Administrator shall transmit such State reports, together with an analysis thereof, to Congress on or before October 1, 1975, and October 1, 1976, and biennially thereafter.

GRANTS FOR SEC. 106. POLLUTION CONTROL PROGRAM

(e) Beginning in fiscal year 1974 the Administrator shall not make any grant under this section to any State which has not provided or is not carrying out as a part of its program—

(1) the establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, and to compile and analyze data on (including classification according to eutrophic condition), the quality of navigable waters and to the extent practicable, ground waters including biological monitoring; and provision for annually updating such data and including it in the report required under section 305 of this Act;

SEC. 204 LIMITATION AND CONDITIONS

(a) Before approving grants for any projection for any treatment works under section 201(g)(1) the Administrator shall determine—

"that (A) the State in which the project is to be located (1) is implementing any required plan under section 303(e) of this Act and the proposed treatment works are in conformity with such plan, or (ii) is developing such a plan and the proposed treatment works will be in conformity with such plan, and (b) such State is in compliance with section 305(b) of this Act;"

SEC. 314. CLEAN LAKES

(a) Each State shall prepare or establish, and submit to the Administrator for his approval—

"(A) an identification and classification according to eutrophic condition of all publicly owned lakes in such State;
"(B) a description of procedures, processes, and methods (including land use requirements), to control sources of pollution of such lakes;
"(C) a description of methods and procedures, in conjunction with appropriate Federal agencies, to restore the quality of such lakes;
"(D) methods and procedures to mitigate the harmful effects of high acidity, including innovative methods of neutralizing and restoring buffering capacity of lakes and methods of removing from lakes toxic metals and other toxic substances mobilized by high acidity;
"(E) a list and description of those publicly owned lakes in such State for which uses are known to be impaired, including those lakes which are known not to meet applicable WQ Standards or which require implementation of control programs to maintain compliance with applicable standards and those lakes in which water quality has deteriorated as a result of high acidity that may reasonably be due to acid deposition; and
"(F) an assessment of the status and trends of water quality in lakes in such State, including but not limited to, the nature and extent of pollution loading from point and nonpoint sources and the extent to which the uses of lakes is impaired as a result of such pollution, particularly with respect to toxic pollution.

"(2) SUBMISSION AS PART OF 305(b) (1) REPORT. – The information required under paragraph (1) shall be included in the report required under section 305(b) (1) of this Act, beginning with the report required under such section by April 1, 1988".

APPENDIX B

Virginia Department of Environmental Quality
Biological Monitoring Program
305(b) Assessment Fact Sheet

Regional Office:
Regional Biologist's Signature: _____
Review Date:
River Basin:
Stream Name and Site Location:
Station ID #:
Reference Station ID #:
Assessment Method:
VSCI
Coastal Plain (MACS)

Biological Assessments for the Last Six Years

Year	Spring score	Spring assessment	Fall score	Fall assessment
2003				
2004				
2005				
2006				
2007				
2008	0.0		0.0	
Seasonal avg 6-yrs	0.0		0.0	
Seasonal avg last 2-yrs	0.0		0.0	
Final 6-yr average	0.0		0.0	
Final 6-yr average	0.0		0.0	

Note, because of the long, six-year time frame covered by this review and for a variety of reasons, some sites may not have been sampled during every year or season and/or an assessment ranking or score may not be available for every "cell" in the above table. The above table is intended to be a convenient method to summarize and review all the data available for the reporting period. The final assessment ranking for each site should be based on a review of all the available rankings shown in the above table and any pertinent supplemental data described below. For the purpose of Integrated Report preparation, if more recent bioassessment rankings differ significantly from earlier rankings, primary consideration should be given to the more recent assessed data. This is described in more detail of section 6.4.2.2 of the Integrated Report Guidance Manual.

Supplemental Information (if applicable):

Are any seasonal differences noted?

Summary of any comments associated with assessments.

Have any factors been observed in watershed that may be affecting the benthic community? Have there been any recent changes in activity in the watershed that may have affected the more recent bioassessments. Are these changes likely to affect the benthic community for a short or long term basis?

Final Assessment Rating:

APPENDIX C

Classification of Virginia's Shellfish Growing Areas

Robert E. Croonenberghs, PhD

The Division of Shellfish Sanitation (DSS) follows the requirements of the National Shellfish Sanitation Program (NSSP), which is regulated by the U.S. Food and Drug Administration. The NSSP classification uses the shoreline survey as its primary tool for classifying shellfish growing waters. Fecal coliform concentrations in seawater samples collected in the immediate vicinity of the shellfish beds function to verify the findings of the shoreline surveys, and to define the border between approved and condemned (unapproved) waters.

DSS uses the shoreline survey to locate as many sources of pollution as possible on the watersheds of shellfish growing areas. DSS conducts a property-by-property inspection of the onsite sanitary waste disposal facilities of many properties on un-sewered sections of watersheds, and investigates other sources of pollution such as wastewater treatment facilities (WWTF), marinas, livestock operations, landfills, etc. The information is compiled into a written report with a map showing the location of the sources of real or potential pollution found, and sends it to the various state agencies that are responsible for regulating these concerns and the city or county. The local health departments (LHDs) of the Virginia Department of Health (VDH) play a major role in the process by obtaining correction of the onsite sanitary waste disposal problems. Most of the Division's effort is focused on locating fecal contamination, and in this manner we prevent significant amounts of human pathogens from getting into shellfish waters. I believe that this is the primary reason why we have not had a confirmed shellfish-borne disease outbreak due to Virginia-grown shellfish in over 40 years. VDH is reducing the input of these pathogens to back yards, waterways, unofficial swimming areas and shellfish waters. The shoreline survey work is the heart of the shellfish program.

In addition to the shoreline survey, the NSSP requires that DSS collect seawater samples in the growing areas as part of the classification procedure. States must use the most recent 30 samples, collected randomly with respect to weather (scheduled one month in advance), to classify a station. The two part standard for fecal coliforms in waters for direct shellfish harvest to market is a geometric mean no greater than 14 MPN fecal coliforms/100 ml and an estimated 90^{th} percentile no greater than 31. Exceeding either number requires closure of that station.

To a lesser degree, the Division collects shellfish samples from sentinel growing areas and has them analyzed for heavy metals and chlorinated hydrocarbons (pesticides and PCBs). Such toxic substances are not a public health threat in Virginia's waters, with the potential exception of the Elizabeth River and perhaps Little Creek, both of which are located in the Hampton Roads area.

Thus, classification based on fecal pollution is a multi-layered and multi-step process. Initially one uses the shoreline survey to determine if there are any actual or potential sources of fresh fecal pollution to the growing area. If so, then the area cannot be used for the direct harvest of shellfish for marketing. Hampton Roads is an example. Most of Hampton Roads is permanently closed, due to the tremendous amount of shipping and the concern of contamination from treated sewage outfalls and runoff from the urban watershed. However, microbiological results are generally acceptable.

Another example of actual or potential pollution that requires closure is a discharge, such as from a WWTF or the potential discharge from boats in marinas. DSS uses relatively simple computer models developed by VIMS, which employ fairly sophisticated mathematics, to determine the size of buffer zones around these sources. These models use inputs of fecal coliforms (estimated from sewage treatment facility outfall volumes or factors related to the number and size of boats in marinas), die-off factors, and readily available tidal current and channel configuration information. Buffer zones around marinas are typically only in effect during the warmer boating months (April 1 - October 31). Once these buffer zones are determined, they do not change in size unless the capacity of the WWTF or the marina changes.

Our third layer of classification, and our most common in Virginia, consists of evaluating areas that are not affected by urban runoff or significant wastewater discharges. One must evaluate the watershed for the potential impacts of

known failing onsite sanitary waste facilities to estimate whether their input could be of such a magnitude as to require closure, even if the water quality data is acceptable. If the impact from these failing systems does not appear to pose an undue threat, then the water quality data can be used to verify whether the waters should be classified as approved or not.

Since DSS generally collects samples monthly, this means that our geometric mean incorporates data reaching back 2.5 to 3 years. Heavy rainfall or very high tides due to winds or moon phase can wash unusually high concentrations of fecal coliforms into shellfish growing areas that can increase the geometric mean or the 90th percentile beyond the allowed standard. As more data is collected and the unusually high concentrations fall off the trailing end of the data set, the water quality then appears to improve. This is one of the factors that can cause a continual fluctuation in the classification of the water quality at the interface between impacted upstream waters and the relatively unaffected downstream water body.

Since DSS is not a research organization, we cannot do much to determine the cause of water quality deterioration in areas. However, the Division has tried over the years to do so, and we have encouraged the State to put resources into determining those causes. The Division has found that obviously failing septic systems are almost never the cause of deteriorating water quality in a large body of water. We have seen areas where impacts on fecal coliform concentrations in smaller bodies of water occur due to failing onsite sanitary waste disposal systems, but these seem to be rare. This should not be taken to downplay the concern from such failing onsite sanitary waste disposal systems, since even small inputs of fecal coliforms from these systems are quite likely to contain significant concentrations of human pathogens. Indeed, failing onsite sanitary waste disposal systems are one of the types of pollution sources of greatest concern with regard to the consumption of bivalve molluscan shellfish. New data indicates that drainfields located in seasonally high water tables may contribute significant numbers of fecal coliforms to impact water quality, and research into this potential source is needed and ongoing.

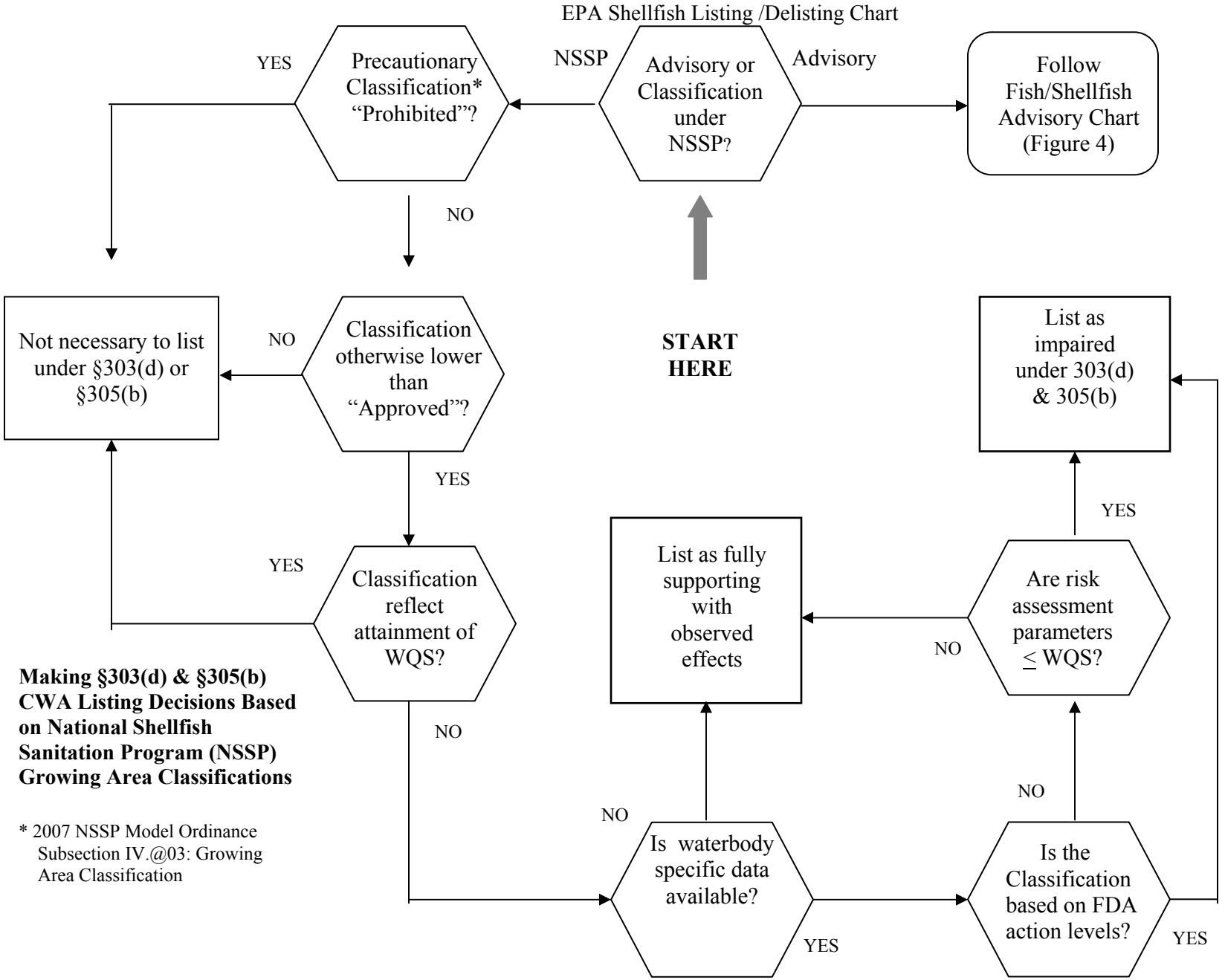
Virginia's urban suburban watersheds like the Lynnhaven River in Virginia Beach are clearly impacted by the flushing action of rapid runoff from storm drains. Water quality in much of the Lynnhaven River has deteriorated over time along with development and high bacteria counts after runoff events being predictable. Other areas are much less predictable. Sometimes heavy rainfalls cause elevated counts in rural areas and sometimes they do not. Part of this is due to spotty thunderstorms that are not reflected by the relatively few rain gauge sources.

In more rural areas the wildlife component of fecal coliform inputs is significant, as can be the human input. Wildlife, such as raccoons, muskrats and deer, living near the intertidal zone, can have dramatic local impacts on fecal coliform concentrations in the adjacent shellfish waters. Wildlife within a watershed are potential sources for Cryptosporidium and Giardia inputs, though the NSSP has not decided how to handle these problems specifically. New data indicates that wildfowl can have significant impacts on water quality too. Wildlife inputs of fecal material are basically accounted for by the seawater sampling data.

The Division is not seeing a steady increase in the number of acres of condemned waters in the state. Instead, what we see are fluctuations in the location of the border between acceptable and unacceptable water quality measurements moving up and down tributaries over time. Again, these fluctuations seem to be due largely to changing factors on the watershed, chance weather events (rain, high tides), changes in wildlife populations near shore or unknown factors (perhaps movement of livestock from one field to another, migratory bird flocks, or runoff from recently plowed fields that later contribute little when crops stabilize the soil).

Man does directly impact the fecal coliform counts in the waters. The headwaters of smaller streams are impacted by development due to the loss of the filtering and detention of runoff waters through upland swamps and other slow moving water areas. These natural detention areas provide the extended time element so that predators (rotifers and ciliates) and sunlight can reduce the numbers of fecal coliforms. When these are replaced with drainage systems the fecal coliforms are directly discharged into the shellfish waters.

Figure 5


EPA Shellfish Listing /Delisting Chart
Advisory or Classification under NSSP?
NSSP
Advisory
Follow Fish/Shellfish Advisory Chart (Figure 4)
Precautionary Classification* "Prohibited"?
YES
NO
START HERE
Classification otherwise lower than "Approved"?
NO
Not necessary to list under §303(d) or §305(b)
YES
Classification reflect attainment of WQS?
YES
NO
List as impaired under 303(d) & 305(b)
YES
Are risk assessment parameters ≤ WQS?
NO
List as fully supporting with observed effects
NO
Is waterbody specific data available?
YES
NO
Is the Classification based on FDA action levels?
YES
Making §303(d) & §305(b) CWA Listing Decisions Based on National Shellfish Sanitation Program (NSSP) Growing Area Classifications
* 2007 NSSP Model Ordinance Subsection IV.@03: Growing Area Classification

APPENDIX D

Incorporating the *Proactive Approach* to delisting 303(d) listed segments into the 2010 Water Quality Assessment

For the 1998 assessment cycle, EPA changed the data analysis period for the 305(b) assessment from two to five years. Virginia's water quality assessments and the subsequent 303(d) list have since been based on a 5-year data window. In 2008 the assessment data window was expanded to six years to coincide with the two-year ambient watershed rotation monitoring schedule. The data window for 2010 is January 1, 2003 through December 31, 2008.

In August 2001, the Office of Water Quality Programs negotiated with EPA an approach, termed the *Proactive Approach*, which results in the proposed delisting of waters on the Section 303(d) list through assessment of less than six years of data. Correspondence and information related to the issue is attached to this memorandum. In short, EPA Region III has consented that Virginia can delist a segment on the 303(d) list if the following requirements are met:

1) For conventional parameters, no more than one of twelve samples taken over a two-year period exceeds the water quality criteria (<10.5 percent exceedence for larger data sets).
2) For biological impairment, a minimum of 2 consecutive samples, taken over a one to two year period, show attainment of the applicable standard.
3) The samples are taken at the same location (monitoring station) which demonstrated the impairment.
4) A rationale document is submitted to EPA justifying why the State believes the waters are achieving WQ Standards. This rationale document can consist of a description of measures taken in the watershed which are considered to be responsible for improvement of the water quality.

Eligibility and Water Quality Assessment

The following procedure is to be used to consider the eligibility of, and to subsequently assess, any particular waterbody segment submitted for consideration for delisting under the *Proactive Approach*.

Locations where proactive measures are being taken to improve water quality through the TMDL or Water Quality Management Plan program such that the *Proactive Approach* is eligible for consideration are to be provided by the DEQ TMDL program. Assessment staff can recommend segments for consideration, but only those locations provided by the DEQ TMDL program as candidates for the *Proactive Approach* are to be considered for assessment under the *Proactive Approach*. Notification must be made in writing through memorandum to the affected regional assessment manager, copied to the DEQ 305(b) coordinator, and must include the required documentation supporting consideration of the *Proactive Approach*. At a minimum, this is to include documentation of those implementation measures considered to be responsible for improvement in water quality and subsequent achievement of WQ Standards.

Regional assessment staff members are responsible for assessment of water quality in their respective regions and for the defense of their assessments. Therefore, the decision for delisting consideration is to be made by regional assessment staff based on the analysis of the proactive measures being taken, available monitoring data, any ancillary information collected, and their professional knowledge of site specific influences on water quality in the affected segment.

Where there is agreement between TMDL program and assessment staff that it is appropriate to pursue delisting based on implementation of the *Proactive Approach*, the assessment must be performed based on the requirements outlined in 1, 2 and 3 above. For a scheduled 305(b)/303(d) assessment, only the last two years of the assessment window are to be used for assessment of eligible segments. For delisting assessment at any other time, the most recent two years of data must be used.

Assessment Documentation and Delisting Procedure

ADB Database	A segment meeting the above criteria is considered monitored, fully supporting. The assessment comments section should include the phrase *Proactive Approach Assessment*. The *Proactive Approach* data window used must be specifically identified.
Delisting Documentation	Documentation must include the information provided by the TMDL program related to control measures implemented using the *Proactive Approach* (requirement 4, above), and the results of data analysis related to requirements 1, 2, and 3 above.
EPA Review, Approval and Public Participation	Fulfillment of EPA review and approval requirements, and fulfillment of public participation requirements for removal of waterbody segments (delisting) at EPA required 303(d) list submittal dates, is the responsibility of the Monitoring and Assessments Program. At other times, fulfillment of these requirements in an effort to delist waters not needing TMDLs is the responsibility of the TMDL program. Final documentation for segments delisted by the TMDL program staff must be provided to the regional assessment manager and copied to the DEQ 305(b) coordinator at least five months prior to any EPA required 303(d) list submittal date, if time permits.

APPENDIX E-1

FISH TISSUE VALUES (TV)*		NON CARCINOGEN	CARCINOGEN
		CRITERION BASED TISSUE VALUE (TV)	CRITERION BASED TISSUE VALUE (TV)
COMPOUND	CAS #	PPB (wet–weight)	PPB (wet-weight)
Acenaphthene	83-32-9	240,000.00	
Acrolein	107-02-8	2,000.00	
Acrylonitrile	107-13-1		74
Aldrin	309-00-2		2.40
Anthracene	120-12-7	12,000,000	
Antimony	7440-36-0	1,600	
Benzene	71-43-2		2,700
Benzidine	92-87-5		0.17
Benzo(a)anthracene	56-55-3		5.50
Benzo(b)fluoranthene	205-99-2		5.50
Benzo(k)fluoranthene	207-08-9		5.50
Benzo(a)pyrene	50-32-8		5.50
Bis2-chloroethyl ether	111-44-4		36
Bis2- chloroisoproply ether	108-60-1	160,000	
Bis2- ethylhexyl Phthalate	117-81-7	2,900	
Bromoform	75-25-2		5,100
Butyl benzyl phthalate	85-68-7	800,000	
Carbon tetrachloride	56-23-5		310
Total Chlordane	57-74-9		110
Chlorobenzene	108-90-7	16,000	
Chlorodibromomethane	124-48-1		480
2-Chloronaphthalene	91-58-7	320,000	
Chloroform	67-66-3		40,000
2-Chlorophenol	95-57-8	20,000	
Chrysene	218-01-9		5.50
Cyanide	57-12-5	80,000	
DDD	72-54-8		170
DDE	72-55-9		120
Total DDT	50-29-3		120
Dibenz(a,h)anthracene	53-70-3		5.50
1,2-Dichlorobenzene	95-50-1	72,000	
1,3-Dichlorobenzene	541-73-1	54,000	
1,4-Dichlorobenzene	106-46-7	11,000	
3,3-Dichlorobenzidine	91-94-1		89
Dichlorobromomethane	75-27-4		650
1,2-Dichloroethane	107-06-2		440
1,1-Dichloroethylene	75-35-4	40,000	
1,2-Trans-dichloroethylene	156-60-5	16,000	
2,4-Dichlorophenol	120-83-2	12,000	
1,2-Dichloropropane	78-87-5		600
1,3-Dichloropropene	542-75-6	400	
Dieldrin	60-57-1		2.50
Diethyl phthalate	84-66-2	3,200,000	
2,4-Dimethylphenol	105-67-9	80,000	
Dimethyl Phyhlate	131-11-3	40,000,000	
Di-n-butyl phthalate	84-74-2	400,000	

2,4-Dinitrophenol	51-28-5	8,000	
2-Methyl-4,6-dinitrophenol	534-52-1	1,600	
2,4-Dinitrotoluene	121-14-2		130
Dioxin	1746-01-6		0.00026
1,2-Diphenylhydrazine	122-66-7		50
Endosulfan (1 and II)	115-29-7	24,000	
Endosulfan sulphate	1031-79-8	24,000	
Endrin	72-20-8	240	
Endrin aldehyde	7421-93-4	1,200	
Ethylbenzene	100-41-4	80,000	
Fluoranthene	206-44-0	160,000	
Fluorene	86-73-7	160,000	
Heptachlor	76-44-8		8.90
Heptachlor epoxide	1024-57-3		4.40
Hexachlorobenzene	118-74-1		25
Hexachlorobutadiene	87-68-3		510
Hexachlorocyclohexane (alpha-BHC)	319-84-6		6.30
Hexachlorocyclohexane (beta -BHC)	319-85-7		22
Hexachlorocyclohexane (gama-BHC) (lindane)	58-89-9		240
Hexachlorocyclopentadiene	77-47-4	4,800	
Hexachloroethane	67-72-1		2,900
Indeno(1,2,3-cd)pyrene	193-39-5		5.5
Isophrone	78-59-1		42,000
Mercury (Methyl) **	22967-92-6	300	
Methyl Bromide	74-83-9	5,600	
Methylene Chloride	75-09-2		5,300
Nickel	744-00-2	220,000	
Nitrobenzine	98-95-3	2,000	
N-nitrosodimethylamine	62-75-9		0.78
N-nitrosodiphenylamine	86-30-6		8,200
N-nitrosodi-n-propylamine	621-64-7		5.70
PCB Total/congeners	1336-36-3		20
Pentachlorophenol	87-86-5		330
Phenol	108-95-2	1,200,000	
Pyrene	129-00-0	120,000	
Selenium	7782-49-2	20,000	
1,1,2,2-Terachloroethane	79-34-5		200
Tetracholoethylene	127-18-4		1,000
Thalium	7440-28-0	54	
Toluene	108-88-3	64,000	
Toxaphene	8001-35-2		36
1,2,4-Trichlorobenzene	120-82-1	8,000	
1,1,2-Trichloroethane	79-00-5		700
Trichloroethylene	79-01-6		3,200
2,4,6-Trichlorophenol	88-06-2		3,600
Vinyl Chloride	75-01-4		29
Zinc	7440-66-6		1,200,000

*These fish tissue values have been calculated based on the Water Quality Standards that are associated with the latest Triennial Review criteria proposals as adopted by the State Water Control Board in October 2008.

**The fish tissue criterion for methylmercury applies to fish species commonly eaten in the local waterbody and applies to most fish species in the DEQ database except bowfin or longnose gar because fish consumption surveys show that these species are rarely consumed in Virginia. Total mercury concentrations in fish tissue are assumed to equal methylmercury concentrations.

APPENDIX E-2

RISK-BASED TISSUE SCREENING VALUE (TSVs) FOR FISH TISSUE UPDATED FROM INTEGRATED RISK INFORMATION SYSTEM (IRIS) FOR GENERAL POPULATION (ADULT)

BODY WEIGHT (KG) 70
RISK LEVEL 10^{-5}
CONSUMPTION RATE (KG/DAY) 0.0175

Fish Tissue Screening Values (TSV)		NON CARCINOGEN	CARCINOGEN
		TISSUE SCREENING VALUE (TSV)	TISSUE SCREENING VALUE (TSV)
COMPOUND	CAS #	PPB (wet-weight)	PPB (wet-weight)
Arsenic (inorganic)	7440-38-2		270*
Barium	7440-39-3	800,000	
BHC isomers	608-93-1		0
Brominated Diphenyl ethers (BDEs)			5000 (VDH)**
Cadmium	7440-43-9	4,000	
Decabromdiphenyl ether	1163-19-5		28,000
Hexabromodiphenyl ether	36483-60-0		800
Pentabromodiphenyl ether	32534-81-9		8,000
Chromium III	16065-83-1	6,000,000	
Chromium VI	18540-29-9	12,000	
Chlorpyrifos	2921-88-2	12,000	
Diazinon	333-41-5	3600	
Disulfoton	298-04-4	160	
Ethion	563-12-2	2,000	
Kepone	143-50-0		300 (VDH)**
Methoxychlor	72-43-5	20,000	
Mirex	2385-85-5	8,000	
Oxyfluorfen	42874-03-3	12,000	
PAHs (sum PEC) ***			15
Terbufos	13071-79-9	100	
Tributyltin	56-35-9	1,200	

*The screening value for arsenic applies to inorganic arsenic only. Organic forms of arsenic are not carcinogenic and are relatively nontoxic. There is a general consensus that 85to >90% of arsenic found in fish tissue is organic arsenic. The screening value of 270 ug/kg total arsenic is based on the estimate that 10% of total arsenic detected in fish tissue is inorganic arsenic.

** These values are based on recent changes to the toxicological data used to calculate the screening values, or recent recommendations from U.S. EPA or the Virginia Department of Health. These screening values are not based on the same toxicological data that were used to develop the existing water quality criteria.

*** Mixtures of seven polynuclear aromatic hydrocarbons (PAHs) that are classed as probable human carcinogens were assessed based on a screening value concentration of 15 ppb calculated as a sum potency equivalency concentration (PEC) using methods described in EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol. 1, (EPA 823-R-95-007) and Vol. 2 (EPA 823 B-00-008) using the following equation;

$$PEC = \sum_{i} (RPi \times Ci)$$

where; RPi = relative potency for the ith PAH
Ci = concentration of the ith PAH in fish tissue)

The relative potency estimates used for these PAHs were:

Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.145
Benzo(b) fluoranthene	0.167
Benzo(k)fluoranthene	0.020
Chrysene	0.0044
Dibenz(a,h)anthracene	1.11
Indeno(1,2,3-cd)pyrene	0.055

APPENDIX F

Freshwater Consensus- Based Sediment Screening Values (SVs)

Analyte (Metals)	**Consensus PEC (ppm) dry weight**
Arsenic	33
Cadmium	4.98
Chromium	111
Copper	149
Lead	128
Mercury	1.06
Nickel	48.6
Silver	NA
Zinc	459
Analyte (Organics/Pesticides)	**Consensus PEC (ppb) dry weight**
Acenaphthene	NA
Acenaphthylene	NA
Anthracene	845
Benzo-a-pyrene	1,450
Benz(a)Anthracene	1,050
Chrysene	1,290
Dibenz[a,h]Anthracene	NA
Fluoranthene	2230
Fluorene	536
Methylnaphthalene, 2-	NA
Naphthalene	561
Phenanthrene	1,170
Pyrene	1,520
LMW PAHs	NA
HMW PAHs	NA
Total PAHs ** (see footnote)	22,800
Chlordane	17.6
DDD	28
DDE	31.3
DDT	62.9
DDT, total	572
Dieldrin	61.8
Total PCBs	676
Endrin	207
Heptachlor Epoxide	16
Lindane	4.99
NA = Not Available	

Estuarine NOAA-based ER-M Sediment Screening Values (SVs)

Trace Elements (Metals)	ER-M Value ppm (dry weight)
Antimony (Sb)	NA
Arsenic (As)	70
Beryllium	NA
Cadmium (Cd)	9.6
Chromium (Cr)	370
Copper (Cu)	270
Lead (Pb)	218
Manganese (Mn)	NA
Mercury (Hg)	0.71
Nickel (Ni)	51.6
Selenium (Se)	NA
Silver (Ag)	3.7
Thallium	NA
Zinc (Zn)	410

Pesticides and Other Organic Substances –parts per billion dry weight

CAS #	Substance	ER-M Value(dry weight) (ppb)	
336363	Polychlorinated Biphenyls (PCBs)	180	
309002	Aldrin	NA	
57749	Chlordane	6	
NA	total DDT (include metabolites)	46.1	
72548	DDD	20	
50293	DDT	7	
72559	DDE	27	
60571	Dieldrin (EPA proposed criteria)	8	
72208	Endrin	NA	
76448	Heptachlor	NA	
1024573	Heptachlor epoxide	NA	
118741	Hexachlorobenzene	NA	
608731	Hexachlorocyclohexane	NA	
58899	Lindane	NA	
2385855	Mirex	NA	
108952	Phenol	NA	
117817	Di (2-Ehtylhexyl) Phthalate	NA	
84742	N-Butyl Phthalate	NA	
83329	Acenapthene	500	LMW P AH
208968	Acenapthylene	640	LMW PAH
120127	Anthracene	1100	LMW PAH
50328	Benzo-A-Pyrene	1600	HMW PAH
191242	Benzo [GHI] Perylene	NA	HMW PAH
56553	Benz[A] Anthracene	1600	HMW PAH
218019	Chrysene	2800	HMW PAH
53703	Dibenz [A,H] Anthracene	260	HMW PAH
206440	Fluoranthene	5100	HMW PAH
86737	Fluorene	540	LMW PAH
193395	Indeno (1,2,3-CD)Pyrene	NA	HMW PAH
91576	Methylnaphthalene, 2	670	LMW PAH
91203	Naphthalene	2100	LMW PAH
85018	Phenanthrene	1500	LMW PAH

129000	Pyrene	2600	HMW PAH
NA	Low Molecular Weight (LMW)PAHs		3160
NA	High Molecular Weight (HMW) PAHs		600
NA	Total PAHs **(see footnote)		44,792

*Changes or updates to any of the ER-M or PEC screening values should be updated in the assessment spreadsheet used to calculate the estuarine weight of evidence.
**sum of 24 Polyaromatic hydrocarbons used in previous reports, also polynuclear aromatic hydrocarbons (PNAs)

DEQ acknowledges the use of the ER-M or PEC may be limited (for several reasons) in their ability to accurately predict biological effects. Given that DEQ continues to employ the collection of bulk sediment with chemical analysis as a cost-effective way to monitor a great number of sediment sites, these thresholds are an appropriate tool for assessing sediment data relative to its potential harm to aquatic life.

Citation:

Freshwater PECs*:* MacDonald, D.D., C.G. Ingersoll, T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Arch. Environ. Contam. Toxicol.* 39:20-31.

Estuarine ER-Ms*:* Buchanan, M.F. 1999 National Oceanic and Atmospheric Administration *Screening Quick Reference Tables,* NOAA HAZMAT Report 99-1 Seattle, WA, Hazardous Materials Response and Assessment Division, 12 pages.

APPENDIX G

SIGNIFICANT LAKES/RESERVOIRS BY REGION

Northern Regional Office – 18 Reservoirs/Lakes

Abel Lake	Stafford Co.	174 (Acres)	PWS
Aquia Reservoir (Smith Lake)	Stafford Co.	131	PWS
Beaverdam Reservoir	Loudoun Co.	301	PWS
Breckenridge Reservoir	Prince William Co.	47	PWS
Burke Lake	Fairfax Co.	208	VDGIF
Curtis Lake	Stafford Co.	58	
Goose Creek Reservoir	Loudoun Co.	40	PWS
Hunting Run Reservoir	Spotsylvania Co.	440	PWS
Lake Anna	Louisa, Spotsylvania, Orange	9,595	
Lake Manassas	Prince William Co.	675	PWS
Lake Orange	Orange Co.	130	VDGIF
Lake Pelham	Culpeper Co.	250	PWS
Lunga Reservoir	Prince William Co.	477	PWS
Motts Run Reservoir	Spotsylvania Co.	137	PWS
Mountain Run Lake	Culpeper Co.	73	PWS
Ni Reservoir	Spotsylvania Co.	408	PWS
Northeast Creek Reservoir	Louisa Co.	178	PWS
Occoquan Reservoir	Fairfax, Prince William Co.	1,328	PWS

Piedmont Regional Office – 15 Reservoirs/Lakes

Amelia Lake	Amelia Co.	98	VDGIF
Brunswick Lake	Brunswick Co.	138	VDGIF
Lake Chesdin	Chesterfield Co.	3,164	PWS
Chickahominy Lake	Charles City Co.	1,049	PWS
Diascund Creek Reservoir	New Kent Co.	1,055	PWS
Emporia Lake	Greensville Co.	260	PWS
Falling Creek Reservoir	Chesterfield Co.	88	
Great Creek Reservoir	Lawrenceville	219	
Harrison Lake	Charles City Co.	60	
Lake Nottoway	Nottoway Co.	161	PWS
Lakeview Reservoir	Chesterfield Co.	43	
Little Creek Reservoir	James City Co**.**	926	PWS
Powhatan Lake (U & L)	Powhatan Co.	61	
Swift Creek Lake	Chesterfield Co.	102	
Swift Creek Reservoir	Chesterfield Co.	1,581	PWS

Blue Ridge Regional Office - Lynchburg – 23 Reservoirs/Lakes

Banister Lake	Halifax Co.	352	PWS
Briery Creek Lake	Prince Edward Co.	825	VDGIF
Cherrystone Reservoir	Pittsylvania Co.	104	PWS
Georges Creek Reservoir	Pittsylvania Co.	8	PWS
Graham Creek Reservoir	Amherst Co.	40	PWS
Holiday Lake	Appomattox Co.	113	
Kerr Reservoir (Va.'s portion)	Halifax Co.	33,300	ACOE/PWS
Keysville Reservoir	Charlotte Co.	36	PWS

Lake Conner	Halifax Co.	98	VDGIF
Lake Gordon	Mecklenburg Co.	115	VDGIF
Lake Gaston (Va.'s portion)	Brunswick Co.	5,614	PWS
Lunenburg Beach Lake	Town of Victoria	12	PWS
Mill Creek Reservoir	Amherst Co.	190	
Modest Creek Reservoir	Town of Victoria	20	PWS
Nottoway Falls Lake	Lunenburg Co.	32	PWS
Fort Pickett Reservoir	Nottoway Co.	319	
Pedlar Lake	Amherst Co.	118	PWS
Phelps Creek Reservoir	Campbell Co.	19	PWS
Roaring Fork	Pittsylvania Co.	19	PWS
Sandy River Reservoir	Prince Edward Co.	758	
Stonehouse Creek Reservoir	Amherst Co.	34	
Thrashers Creek Reservoir	Amherst Co.	32	
Troublesome Creek Reservoir (SCS Impoundment #2)	Buckingham Co.	53	PWS

Southwest Regional Office – 11 Reservoirs

Bark Camp Lake	Scott Co.	29	USFS
Big Cherry Lake	Wise Co.	103	PWS
Hidden Valley Lake	Russell Co.	58	VDGIF
Hungry Mother Lake	Smyth Co.	100	DCR
J. W. Flannagan Reservoir	Dickenson Co.	1,177	ACOE/PWS
Lake Keokee	Lee Co.	97	VDGIF
Laurel Bed Lake	Russell Co.	312	VDGIF
North Fork Pound Reservoir	Wise Co.	116	ACOE/PWS
Rural Retreat Lake	Wythe Co.	85	VDGIF
South Holston Reservoir	Washington Co.	1,699	TVA/PWS
Wise Reservoir	Wise Co.	46	WISE/PWS

Tidewater Regional Office – 21 Reservoirs/Lakes

Airfield Pond	Sussex Co.	120	VDGIF
Harwood Mills Reservoir	York Co.	258	PWS
Lake Burnt Mills	Isle of Wight Co.	638	PWS
Lake Cohoon	Suffolk City	454	PWS
Lake Drummond	Suffolk City	3,242	
Lake Kilby	Suffolk City	200	PWS
Lake Lawson	Virginia Beach	75	
Lake Meade	Suffolk City	490	PWS
Lake Prince	Suffolk City	709	PWS
Lake Smith	Norfolk City	185	PWS
Lake Whitehurst	Norfolk City	495	PWS
Lake Wright	Norfolk City	12	
Lee Hall Reservoir	Newport News	290	PWS
Little Creek Reservoir	Norfolk City	200	PWS
Lone Star Lake F	Suffolk City	19	PWS
Lone Star Lake G	Suffolk City	90	PWS
Lone Star Lake I	Suffolk City	33	PWS
Speights Run Lake	Suffolk City	118	PWS
Stumpy Lake	Virginia Beach	263	
Waller Mill Reservoir	York Co.	288	PWS
Western Branch Reservoir	Norfolk City	1,205	PWS

Valley Regional Office – 21 Reservoirs/Lakes

Beaver Creek Reservoir	Albemarle Co.	96	PWS
Chris Green Lake	Albemarle Co	57	
Coles Run Reservoir	Augusta Co.	11	USFS/PWS
Douthat Lake	Bath Co.	47	
Elkhorn Lake	Augusta Co.	51	USFS/PWS
Fluvanna Ruritan Lake	Fluvanna Co.	51	
Lake Arrowhead	Page Co.	36	
Lake Albemarle	Albemarle Co.	37	
Lake Frederick	Frederick Co.	67	VDGIF
Lake Nelson	Nelson Co.	41	
Lake Robertson	Rockbridge Co.	24	
Mount Jackson Reservoir	Shenandoah Co.	1	
Ragged Mountain Reservoir	Albemarle Co.	71	PWS
Rivanna Reservoir	Albemarle Co.	399	PWS
Shenandoah Lake	Rockingham Co.	36	
Silver Lake	Rockingham Co.	11	PWS
Staunton Dam Lake	Augusta Co.	21	PWS
Strasburg Reservoir	Shenandoah Co.	5	
Switzer Lake	Rockingham Co.	99	USFS/PWS
Sugar Hollow Reservoir	Albemarle Co.	47	PWS
Totier Creek Reservoir	Albemarle Co.	37	PWS

Blue Ridge Regional Office - Roanoke – 18 Reservoirs/Lakes

Beaverdam Creek Reservoir	Bedford Co.	70	PWS
Bedford (Stony Cr.) Reservoir	Bedford Co.	28	PWS
Carvin Cove Reservoir	Botetourt Co.	632	PWS
Claytor Lake	Pulaski Co.	4,287	PWS
Clifton Forge (Smith Cr.) Reservoir	Alleghany Co.	10	PWS
Falling Creek Reservoir	Bedford Co.	18	PWS
Fairystone Lake	Henry Co.	127	
Gatewood Reservoir	Pulaski Co.	176	PWS
Hogan Lake	Pulaski Co.	36	PWS
Leesville Reservoir	Bedford Co.	2,630	PWS
Little River Reservoir	Montgomery Co.	60	PWS
Martinsville Reservoir	Henry Co.	181	PWS
Lake Moomaw	Bath Co.	2,389	ACOE
Philpott Reservoir	Henry Co.	2,813	ACOE
Smith Mountain Lake	Bedford Co.	19,820	PWS
Spring Hollow Reservoir	Roanoke Co.	113	PWS
Talbott Reservoir	Patrick Co.	141	
Townes Reservoir	Patrick Co.	28	

Total 127 = Significant Reservoirs/Lakes statewide
PWS = Public Water Supply
VDGIF = Virginia Department of Game and Inland Fisheries
ACOE = Army Corps of Engineers
TVA = Tennessee Valley Authority
Bold = §187 Nutrient WQ Standards apply